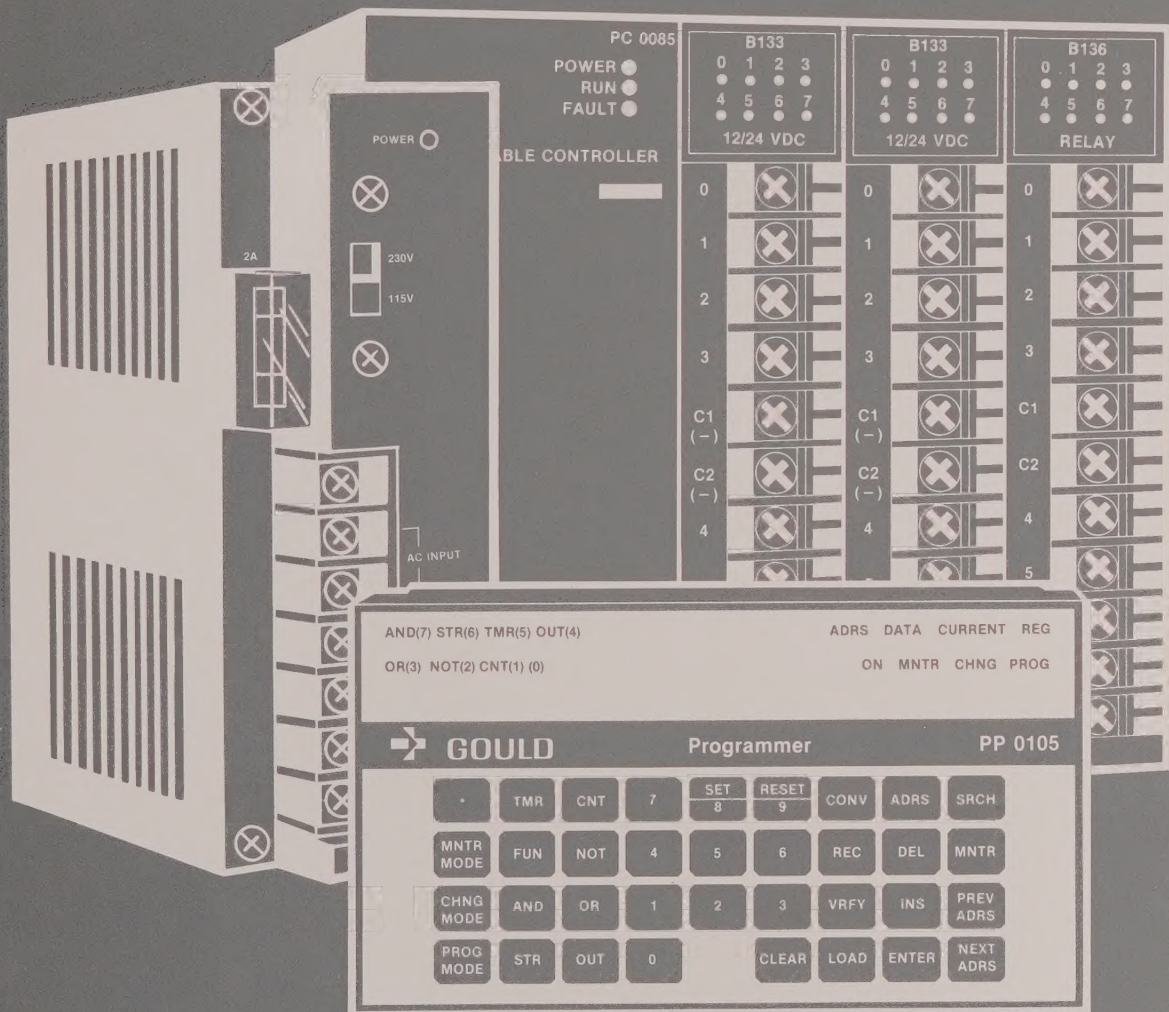


Gould PC 0085 Programmable Controller System User's Manual



GOULD
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GOULD PC0085

PROGRAMMABLE CONTROL SYSTEM

USER'S MANUAL

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NOTE

The PC-0085 has been shipped with a Final System Test Diagnostic in both Program and System Memory. The test is executed automatically at initial power up. If the system completes the diagnostic test satisfactorily, output 110 will go to the ON state 5 seconds after power is applied. The corresponding LED on the output module will light. This test may be accomplished at user incoming inspection, before physical installation, or at any time prior to loading the operational program.

This diagnostic program must be removed before the user program is installed. To remove this diagnostic program from the '085, the System Memory and Program Memory must be cleared. This will reset the System Memory area to the default values and the program area to all No Operation (NOP) instructions.

To clear press:

*	*	PROG	<u>SET</u>
		MODE	8

CLEAR	<u>RESET</u>	ENTER	(the Data Memory is cleared)
	9		

*	*	PROG	<u>SET</u>
		MODE	8

CLEAR	<u>RESET</u>	SYS	ENTER	(the System Memory is
	9	MEM		cleared)

If either the internal or application diagnostics fail to run or give an error indication, reference pages 5-1 thru 5-3, call Gould PCD for technical assistance at 1-800-468-5372. International users call (603) 893-0400 or telex 6817328.

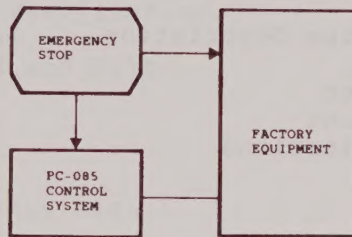
ERRATA SHEET

Please note that the manual references '085 System models A through E have been revised. These model numbers have been superseded by references 001 through 005 respectively. The table below shows the revision relationships for the '085 System line:

	<u>Model as Referenced</u>	<u>New Model Number</u>
Programmable Controllers		
	PC-0085A	PC-0085-001
	PC-0085B	PC-0085-002
	PC-0085C	PC-0085-003
	PC-0085D	PC-0085-004
	PC-0085E	PC-0085-005
I/O		
	DI-1131	DI-1131-000
	DI-1133	DI-1133-000
	DI-1135	DI-1135-000
	DO-1130	DO-1130-000
	DO-1132	DO-1132-000
	DO-1136	DO-1136-000
Programmers		
	PP-0110	PP-0110-000
	PP-0105	PP-0105-000
Power Supply		
	PE-0001	PE-0001-000

----- PRECAUTIONARY NOTES -----

1. Provide an EQUIPMENT EMERGENCY STOP circuit using an external relay circuit.



2. The ground terminal of the unit should not be shared with the ground line of high voltage equipment.
3. The unit should NOT be installed in an area where:
 - Exposed to direct sunlight.
 - The humidity exceeds a range of 35 to 90%RH (non-condensing).
 - Corrosive or flammable gases permeate.
 - Excessive direct vibration or impact is encountered.
4. Eliminate static electricity before touching the unit directly by first touching a grounded metallic object with your hand.
5. Never use organic solvents (like thinner or gasoline) to clean the unit.
6. Never push the keypad with a sharp pointed item such as a pencil point.
7. The keypad must be kept away from welding sparks and hot solder.
8. Keep the interface cable that connects the controller to the programmer away from high voltage, power supply, I/O signal, and the system's power supply lines.
9. Observe correct polarity of the 24VDC lines connecting the PE-0001 Power Supply to the PC-0085 Controller and I/O modules.
10. A backup battery is required to retain the data stored in memory during power failures. A battery expiration label indicates when the battery **MUST** be replaced. A battery level detect circuit is provided to maintain confidence.
11. A loopback connector is installed on the last I/O connector in the I/O to I/O ribbon cable chain. This loopback **MUST** be installed on the last board in the chain so that a self diagnostic can be performed. When extending I/O, be sure that the loopback connector is installed at the end of the added I/O and power is cycled.

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CHAPTER 1. INTRODUCTION

THE GOULD '085 SYSTEM DESCRIPTION.

The GOULD '085 System is a compact yet very powerful programmable control system. It's compact size and high functionality make the GOULD PC-0085 an extremely cost effective programmable controller for small machine or system control. The '085 System not only eliminates the need for cumbersome relays and large PC's but also allows users to integrate more control and greater productivity in a wide variety of applications. The system consists of four unit types:

- PC-0085(A-E) Controller Unit
- PE-0001 Power Supply Unit
- I/O Module Unit
- PP-0105 Programmer

Figure 1-1 shows a System Block Diagram illustrating the relationships between the units comprising the '085 System.

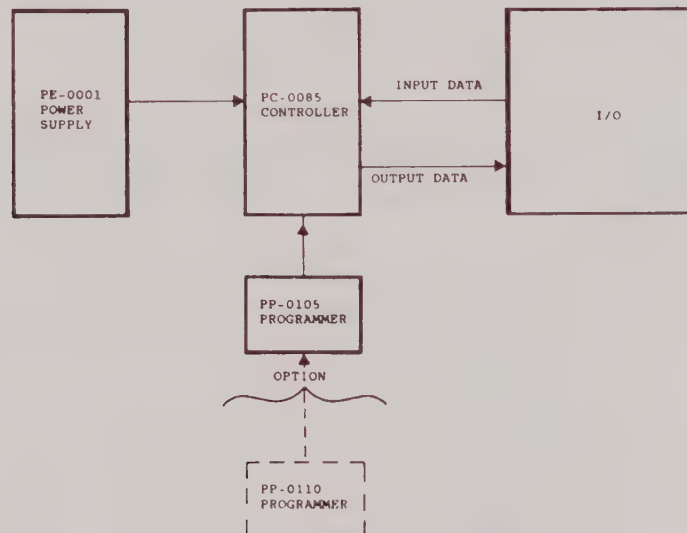


Figure 1-1. '085 System Block Diagram

As shown, the PP-0105 Programmer completes the GOULD '085 System. It is a peripheral device that an operator uses to communicate with the GOULD PC-0085 Controller. Also, this hand-held programmer includes a built-in cassette interface for the recording and reloading of the operating program and data. As an option, Gould's PP-0110 Programmer (part of the GOULD PC-0185 System) is also fully compatible with the '085 System. A cable to connect the PP-0110 Programmer to the PC-0085 Controller is supplied with the PP-0110 Programmer.

FEATURES.

Each system features a memory capacity of 928 words (two bytes/word), fully interchangeable I/O, and a fast scan time (6ms./1K). Other features include:

- High Speed Counter (models B-E)
- I/O Expandability (models B-E)
to 72 Input & 48 Output points
- 115/230 VAC source power operation
using PE-0001 Power supply, or supply
24Vdc directly to Controller.
- 48 Integral timers and counters
- Can be panel mounted or DIN rail mounted
- Very low cost programming panel or
'185 Programmer (PP-0110) can be used.

'085 system models A-E offer the capability of tailoring the mini-PC to the requirements of a small system. The differences between models A-E are summarized in Table 1-2.

The GOULD PC-0085 Programmable Controller delivers larger PC functionality in an extremely compact design. Housed in a compact industrial enclosure that measures less than 35 ins.², the '085 System fits in a wide variety of space-crucial designs. Typical applications include:

- Machining (drill, grind, tap)
- Forming (bend, press, mold, extrude)
- Handling (convey, box, palletizing, stacking)
- Mixing/Blending
- Welding
- Filling/Capping
- Pumping
- Winding
- Assembly
- Gauging
- Energy Management
- Relay Retrofit

SYSTEM CONFIGURATION.

The system is configured according to the model type (suffix A-E). All configurations include the same power supply, a PC controller, and 24 basic I/O points.

Models B thru E differ from model A in that they include a high speed counter and are I/O expandable to a maximum of 72 input and 48 output points. Model A does not offer a high speed counter and is not I/O expandable.

The table below shows the module configurations illustrating the differences between the models.

MODEL	I/O STANDARD CONFIGURATION	TYPE
PC-0085A	2 Input Modules (DI-1133) 1 Output Module (DO-1136)	12/24 VDC Relay
PC-0085B	2 Input Modules (DI-1133) 1 Output Module (DO-1136)	12/24 VDC Relay
PC-0085C	2 Input Modules (DI-1131) 1 Output Module (DO-1130)	110/120 VAC 110/120, 220/240 VAC
PC-0085D	2 Input Modules (DI-1135) 1 Output Module (DO-1130)	220/240 VAC 110/120, 220/240 VAC
PC-0085E	2 Input Modules (DI-1133) 1 Output Module (DO-1132)	12/24 VDC 12/24 VDC

085-101

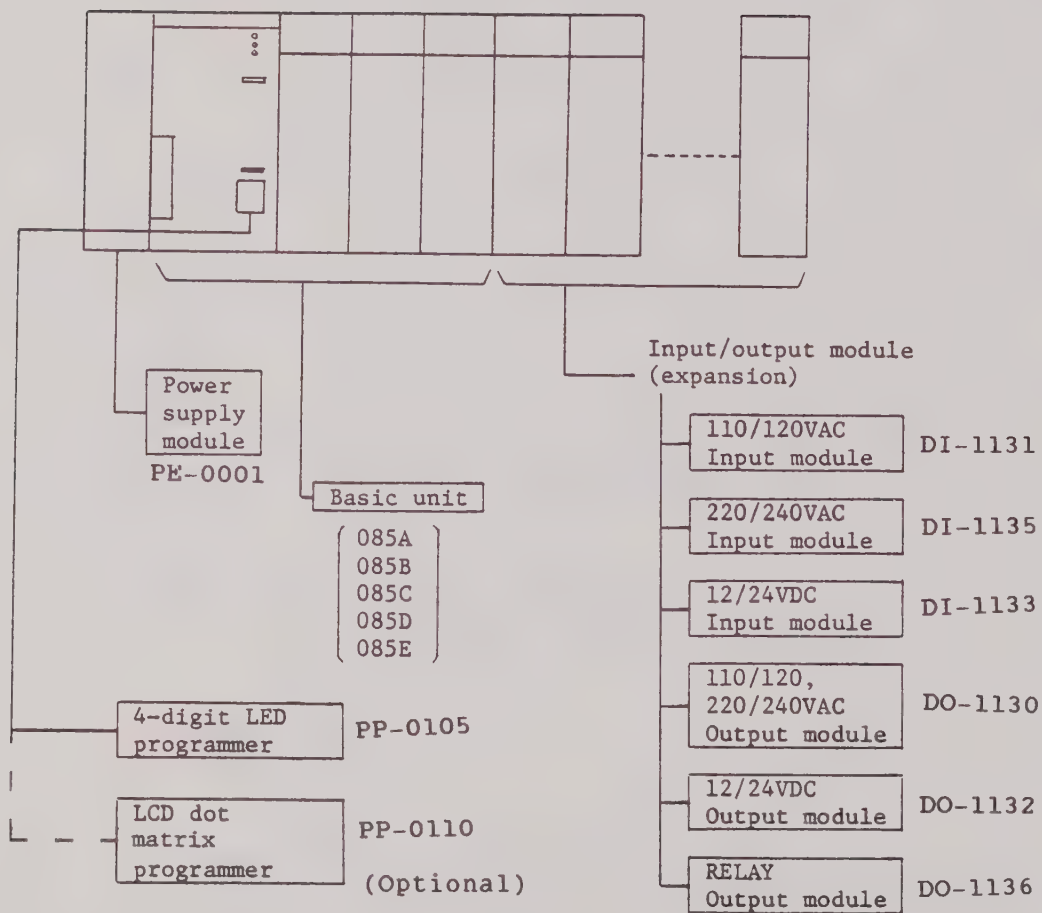


Fig. 1-2 System Configuration

SYSTEM SPECIFICATIONS.

Table 1-1 below provides the general specifications. Following, Table 1-2 lists specifications of the units that comprise the PC-0085 System.

Table 1-1. General Specifications

GENERAL SPECIFICATIONS	'085 SYSTEM
Operational temperature range	32 ~ 140°F (0 ~ 60°C)
Storage temperature range	-4 ~ 158°F (-20 ~ 70°C)
Humidity rating	35 ~ 90% Relative humidity non-condensing
Atmosphere	Must be free from corrosive and flammable gas.
Vibration	16.7 Hz, 3mm amplitude (p - p) each for 2 hours, X, Y, Z axis
Noise immunity	1000Vp-p, 1 usec., by noise simulator between the power lines and ground.

Table 1-2. Unit Specifications

UNIT	MODEL	DESCRIPTION	I/O EXPAND- ABLE
Controller	PC-0085A	CPU Memory Capacity 928 words 12/24Vdc input 16 Points Relay Output 8 Points Without Hi-speed counter	No
	PC-0085B	CPU Memory Capacity 928 words 12/24Vdc Input 16 Points Relay Output 8 Points With Hi-speed counter	Yes
	PC-0085C	CPU Memory Capacity 928 words 110/120Vac Input 16 Points 110/120, 220/240Vac Output 8 Points With Hi-speed counter	Yes
	PC-0085D	CPU Memory Capacity 928 words 220/240Vac Input 16 Points 110/120, 220/240Vac Triac Output 8 Points With Hi-speed counter	Yes
	PC-0085E	CPU Memory Capacity 928 words 12/24Vdc Input 16 Points 12/24Vdc Output 8 Points With Hi-speed counter	Yes
Power Supply	PE-0001	Input: 93.5 ~ 132Vac 187 ~ 250Vac 47 ~ 63Hz Output: 24Vdc	
Input Modules	DI-1131	110/120Vac input	8 Points
	DI-1135	220/240Vac input	8 Points
	DI-1133	12/24Vdc input	8 Points
Output Modules	DO-1130	110/120Vac, 220/240Vac	8 Points
	DO-1132	12/24Vdc	8 Points
	DO-1136	5 ~ 250Vac, 5 ~ 60Vdc Relay Output	8 Points
Programmer	PP-0105	4 digit, 7 segment display, LED status indicators	
	PP-0110	32 character, LCD matrix dot display	

PERFORMANCE SPECIFICATIONS

Table 1-3 below lists the performance specifications for the PC-0085A. Following, Table 1-4 list the performance specifications for the PC-0085B - E. Note that model A is not I/O expandable and offers no high speed counter capability. Table 1-5 lists the specifications for the High Speed Counter, and Table 1-6 lists the performance specifications for the PE-0001 Power Supply.

Table 1-3. PC-0085A

<u>ITEM</u>	<u>SPECIFICATION</u>
Control system	Stored program system (Cyclic processing)
Programming method	Boolean logic symbol (Element at a time)
Scan time	Approx. 6 ms. ave. for 928 words of program not including application instruction, timer, and counter
Instruction set	STR, STR NOT, OR, OR NOT, AND, AND NOT, OUT, AND STR, OR STR, TMR, CNT, SFER, BCD, DCML, CMP, MCS, MCR, END, JCS, JCR, $\neg \uparrow \neg$, $\neg \downarrow \neg$, F/B SFR, NOP
User memory size	928 words
Memory device	CMOS RAM with lithium battery back up
Inputs	16 points
Outputs	8 points
Data memory	
Internal control relays	Regular : 264 points Retentive : 56 points (*1)
Special internal relays	Non-carry flag, Carry flag, Zero flag, 0.1-second clock Preset value change switch, Ever-OFF contact, All output forced OFF, Memory error, CPU failure, I/O failure, Battery Failure, option failure, Power supply failure
Timer/counter	Total 48 timers and counters, any combination Timer range: 0.1 to 199.9 second Counter preset range: 1 to 1999
Allowance of power failure	10ms., maximum
Memory retention (Upon power failure)	Status of retentive relays, current values of counters, and user memory in RAM
Input voltage	24VDC +/- 10% (5% when operated above 50°C)
Weight	960 g (2.12 lbs.)
Consumption current	350mA/24VDC

(Table 1-3. PC-0085A cont.)

- * The number of retentive relays may be increased or decreased by adjusting the retentive relay's starting address.

NOTE-1: The I/O section of this unit contains sixteen 12/24 VDC input points and eight contact outputs. See specifications for input module DI-1133 and output module DO-1136 for details.

Table 1-4. PC-0085B-E

<u>ITEM</u>	<u>SPECIFICATION</u>
Control system	Stored program system (Cyclic processing)
Programming method	Boolean logic symbol (Element at a time)
Scan time	Approx. 6 ms. ave. for 928 words of program not including application instruction, timer, and counter
Instruction set	STR, STR NOT, OR, OR NOT, AND, AND NOT, OUT, AND STR, OR STR, TMR, CNT, SFR, BCD, DCML, CMP, MCS, MCR, END, JCS, JCR, $\neg \uparrow$, $\neg \downarrow$, F/B SFR, NOP
User memory size	928 words
Memory device	CMOS RAM with lithium battery back up
Inputs	72 points
Outputs	48 points
Data memory	
Internal control relays	Regular : 264 points
Special internal relays	Retentive : 56 points (*1) Non-carry flag, Carry flag, Zero flag, 0.1-second clock Preset value change switch, Ever-OFF contact, All output forced OFF, Memory error, CPU failure, I/O failure, High speed counter reset, Battery failure, option failure, Power supply failure
Timer/counter	Total 48 timers and counters, any combination Timer range: 0.1 to 199.9 second Counter preset range: 1 to 1999
Allowance of power failure	10ms., maximum

(Table 1-4 PC-0085B-E cont.)

<u>ITEM</u>	<u>SPECIFICATION</u>		
Memory retention (Upon power failure)	Status of retentive relays, current values of counters, and user memory in RAM		
Input voltage	24VDC +/- 10% (5% when operated above 50°C)		
Weight	962 g (2.12 lbs.)/085B	996 g (2.19 lbs.)/085D	
	996 g (2.19 lbs.)/085C	936 g (2.06 lbs.)/085E	
Consumption current	085B		350mA/24VDC
	085C		300mA/24VDC
	085D		300mA/24VDC
	085E		230mA/24VDC

* The number of retentive relays may be increased or decreased by adjusting the retentive relay's starting address.

Table 1-5. High Speed Counter Specifications

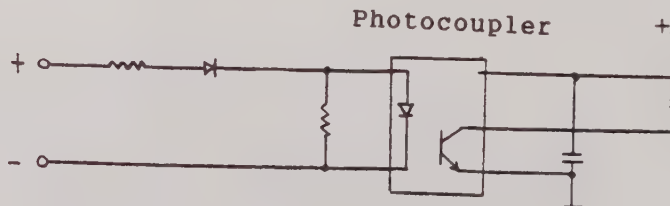
ITEM	SPECIFICATION			
Maximum counting speed	5KPPS, square waveform (minimum pulse width: 100us)			
Counter capacity	4-digit, decimal (counted in the internal relay area J.70 and J.71.)			
Count input method	Single phase addition			
External input signal	Input voltage level	OFF level	2.0 VDC	
		ON level	10.8 VDC	
	Input current level	OFF level	0.5 mA	
		ON level	6.0 mA	
External power supply	Rating	12/24 VDC		
	Maximum voltage	26.4VDC		
Number of terminals	2 (+,-)			
Counter condition	Counted when the internal relay 662 turns on.			
Reset condition	Reset when the internal relay 663 turns on.			
Note	Use the transistor open collector output type for the input device such as the rotary encoder.			
Circuit diagram				
Impedance	+12VDC: About 2Kohms			
	+24VDC: About 1.7Kohms			

Table 1-5 PE-0001 Power Supply Specifications

<u>ITEM</u>	<u>SPECIFICATION</u>
Input voltage	93.5 ~ 132VAC/187 ~ 250VAC (47 ~ 63 Hz)
Output voltage	25.5 $\pm$ 1.2VDC
Maximum output current	1.8 Amps
Input fuse rating	2A, 250V
Power consumption	113W
Dielectric strength	1500VAC, one minute, (between AC input terminal and GND)
Insulation resistance	10Mohms minimum with 500 VDC meg ohm meter (between input terminal and GND)
Weight	560g (1.231 lbs)

INPUT AND OUTPUT NUMBERING.

I/O modules can be configured interchangeably. That is, there are no restrictions on physical or slot locations for modules. I/O module numbers are assigned from the left ascending to the right. Inputs are assigned starting from 000 and outputs begin at 110. Each module represents a byte (symbolized with J.) of data memory. Since each byte is an octal number, there are no locations with numbers 8 or 9.

Modules are numbered sequentially from left to right among those of the same type. If for example, an input module is between two output modules, then that input module number is one byte larger than the previous input module number. If there were no previous input modules, that first input module would correspond to J.00, with input pins of the module corresponding to each bit of that byte. If there were two input modules, then the example module would correspond to J.03. Figure 2-1 illustrates I/O numbering. Table 2-1 following, details the Data Memory Map illustrating the relationship of data memory locations and corresponding bytes to relays areas.

EXAMPLE 1

085B						
000	010	110	020	120	130	030
⋈	⋈	⋈	⋈	⋈	⋈	⋈
007	017	117	027	127	137	037
12/24VDC Input	12/24VDC Input	Relay Output	110/120VAC Input	12/24VDC Output	12/24VDC Output	110/120VAC Input

EXAMPLE 2

085D								
000	010	110	120	130	020	140	030	040
⋈	⋈	⋈	⋈	⋈	⋈	⋈	⋈	⋈
007	017	117	127	137	027	147	037	047
220/240VAC Input	220/240VAC Input	110/120, 220/240VAC Output	110/120, 220/240VAC Output	110/120, 220/240VAC Output	220/240VAC Input	Relay Output	220/240VAC Input	24VDC Input

Figure 2-1. I/O Numbering

Table 2-1. Data Memory Address Map

<u>RELAY NUMBER</u>									<u>BYTE</u>
INPUT RELAY AREA	007	006	005	004	003	002	001	000	] .00
	017	016	015	014	013	012	011	010	] .01
	027	026	025	024	023	022	021	020	] .02
	037	036	035	034	033	032	031	030	] .03
	047	046	045	044	043	042	041	040	] .04
	057	056	055	054	053	052	051	050	] .05
	067	066	065	064	063	062	061	060	] .06
	077	076	075	074	073	072	071	070	] .07
	107	106	105	104	103	102	101	100	] .10
OUTPUT RELAY AREA	117	116	115	114	113	112	111	110	] .11
	127	126	125	124	123	122	121	120	] .12
	137	136	135	134	133	132	131	130	] .13
	147	146	145	144	143	142	141	140	] .14
	157	156	155	154	153	152	151	150	] .15
	167	166	165	164	163	162	161	160	] .16
AUXIL. RELAY AREA	177	176	175	174	173	172	171	170	] .17
	207	206	205	204	203	202	201	200	] .20
	217	216	215	214	213	212	211	210	] .21
	227	226	226	224	223	222	221	220	] .22
	237	236	235	234	233	232	231	230	] .23
	247	246	245	244	243	242	241	240	] .24
	257	256	255	254	253	252	251	250	] .25
	267	266	265	264	263	262	261	260	] .26
	277	276	275	274	273	272	271	270	] .27
	307	306	305	304	303	302	301	300	] .30
	317	316	315	314	313	312	311	310	] .31
	327	326	325	324	323	322	321	320	] .32
	337	336	335	334	333	332	331	330	] .33
	347	346	345	344	343	342	341	340	] .34
	357	356	355	354	353	352	351	350	] .35
	367	366	365	364	363	363	363	360	] .36
	377	376	375	374	373	372	371	370	] .37
	407	406	405	404	403	402	401	400	] .40
	417	416	415	414	413	412	411	410	] .41
	427	426	425	424	423	422	421	420	] .42
	437	436	435	434	433	432	431	430	] .43
	447	446	445	444	443	442	441	440	] .44
	457	456	455	454	453	452	451	450	] .45
	467	466	465	464	463	462	461	460	] .46
	477	476	475	474	473	472	471	470	] .47
	507	506	505	504	503	502	501	500	] .50
	517	516	515	514	513	512	511	510	] .51
	527	526	525	524	523	522	521	520	] .52
	537	536	535	534	533	532	531	530	] .53
	547	546	545	544	543	542	541	540	] .54
	557	556	555	554	553	552	551	550	] .55
	567	566	565	564	563	562	561	560	] .56
	577	576	575	574	573	572	571	570	] .57

Table 2-1. Data Memory Address Map (cont.)

	<u>RELAY NUMBER</u>								<u>BYTE</u>
	607	606	605	604	603	602	601	600	] .60
RETENT.	617	616	615	614	613	612	611	610	] .61
RELAY	627	626	625	624	623	622	621	620	] .62
AREA	637	636	635	634	633	632	631	630	] .63
	647	646	645	644	643	642	641	640	] .64
RETENT.	657	656	655	654	653	652	651	650	] .65
SPECIAL	667	666	665	664	663	662	661	660	] .66
AREA	677	676	675	674	673	672	671	670	] .67
HI-SPEED	707	706	705	704	703	702	701	700	] .70
COUNTER	717	716	715	714	713	712	711	710	] .71
CURRENT									
VALUE AREA									

SCAN TIME

The machine goes into the scanning routine upon completion of the power-up procedure. The scan cycle begins with a hardware check to the end of your program (the F-40 END instruction). When the program execution is completed, the control returns to the hardware check and begins to solve the user logic again. The time required to execute this one cycle is called the scan time.

I/O Unit Processing.

When the selected unit is an input module, the ON/OFF state of the input device connected to it (such as a limit switch) is written into the data memory address corresponding to the input number.

When the selected unit is an output module, the contents of the data memory stored in the address corresponding to the output unit are latched into the output unit so that the output unit changes to ON or OFF.

In the first cycle after power up, the contents of the data memory initialized by the power-up procedure are written in the output module. In the following scans, the operational result for that output unit is written into the output module.

The number of connected I/O modules are checked at power up and input and output operations are carried out according to the number thus determined. This check is not permitted unless the loopback connector is installed on the last connector in the I/O chain. IF THE LOOPBACK CONNECTOR IS NOT INSTALLED THE CPU WILL ASSUME THAT THE MAXIMUM I/O IS CONNECTED (9 input and 6 output modules - Models B-E).

Sections where an input module is connected, but has no field input devices, will be seen as OFF during I/O processing. It cannot be used for auxiliary relays.

Sections where an output module is connected, but has no output field device, can be used for auxiliary relays. The contents of the data memory are written into the output unit during the I/O processing and the LED lights up on the output module.

When an output relay area is used for auxiliary relay in a program but no output device is connected, a great deal of program revision (moving the auxiliary relay to other areas) may be required in order to use an I/O device in this area in the future. Program documentation should note this detail.

Output Signal ON/OFF Time

To gather the data needed to solve a user program, the input states are sensed and written to the data memory at the beginning of each scan. If the inputs change state (OFF to ON or ON to OFF) faster than the scan time, some state changes will be missed. In order to positively reflect the ON/OFF state of the input devices (such as limit switches) the input device's ON time must be greater than the total of one scan time plus the OFF to ON response of the input module. Conversely, the input device's OFF time must be greater than the total of one scan time plus the ON to OFF response time of the input module.

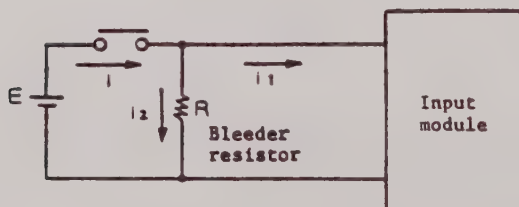
Example: (Assume that you have an AC input unit and a scan time of 5 mSec)

<u>Scan Time</u>		<u>Response Time</u>		<u>Input device's ON time</u>
5	+	10	=	15 (mSec)
5	+	30	=	35 (mSec)

NOTE - The response time of the input modules depends on the charge/discharge characteristics of the input modules. Therefore, the time allowed for state changes (ON to OFF or OFF to ON) will vary.

Using a Bleeder Resistor

Only a certain amount of current can flow through the contact point of an input device. The amount of input current is dependent upon the input impedance and the input voltage. If the current is too high for the contact, install an external bleeder resistor.



$$I = I_1 + I_2 = I_1 + \frac{E}{R}$$

$$\text{Where watt is: } P > \frac{E^2}{R} \times 2$$

Fig. 2-2 Using a Bleeder Resistor

I/O Connection Considerations

1.) Input Devices Having Transistor Outputs:

When connecting a device that has a transistor output to the DC input module, an open collector type output (such as contactless relays, photoelectric switches, proximity switches) is recommended .

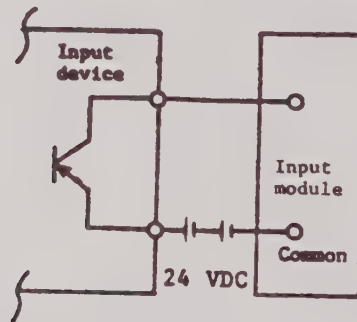


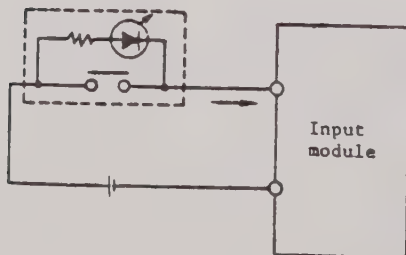
Fig. 2-3 Connecting Open Collector Input Devices

NOTE:

Make sure that the power rating of the transistor can handle the input supply voltage and input current.

2.) Input Device Current

(a) Limit switch with LED



If the LED's drive current is too low, the input section may not go OFF; even if the limit switch is OFF.

Fig. 2-4 LED Limit Switch Example

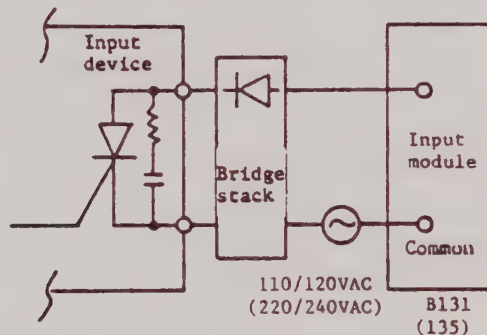
(b) Proximity switch, photoelectric switch

Consumption current flows through the detect circuit even while these devices are OFF (AC, 2-wire types). Therefore, the input module may not turn OFF. For "leakage current" (photoelectric switches), make sure that the value is below the OFF level of the input module.

3.) Input devices with triac or thyristor output circuits:

Since some devices contain an RC network as surge suppression (to prevent arcing of the triac or thyristor), the leakage current in the RC network may delay the recognition of the input device's OFF condition. Though it is preferable to remove the RC network, the value of C should be less than 0.033 μ F for 110/120 VAC or below 0.015 μ F for 220/240 VAC if it is not possible to remove the network.

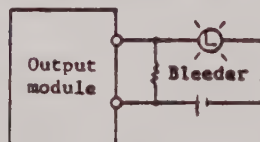
Fig. 2-5 Thyristor Output Example



4.) Lamp Load and Instantaneous Current

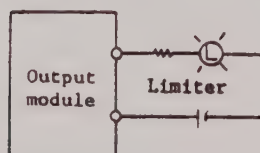
For incandescent lamp loads, an instantaneous current of 10 to 20 times the normal current will exist for a period of about 10 milliseconds. There are two ways to reduce this current: by inserting a bleeder resistor or a current limiting resistor.

(a) Bleeder resistor



A small amount of current (that does not activate the lamp) should be applied during the OFF time of the output module.

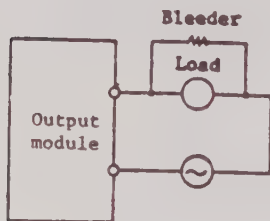
(b) Current limiting resistor



The resistor value should be determined on the basis of the brightness required when the lamp is ON.

5.) Triac Output Module (DO-1130) Leakage Current

Since a triac protective circuit is implemented in the Triac Output Module (DO-1130), there is a leakage current of less than 3 mA during the OFF time. To reduce the possibility that the load does not go OFF because of this leakage current, a bleeder resistor should be inserted in parallel to the load.



The value of resistor must be calculated on the basis of the load used. (About 10K ohms and 5 watts for 110/120 VAC or 20 watts for 220/240 VAC).

Fig. 2-6 Using a Bleeder Resistor with Triac Output

6.) Driving a Large Current Inductive Load with the Transistor Output Module (DO-1132)

A surge absorbing diode is contained internally in order to prevent destruction of the output transistor due to a surge occurring when the module is connected with the load).

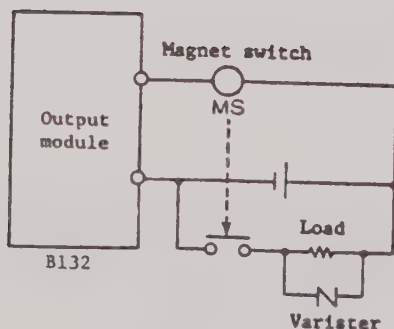


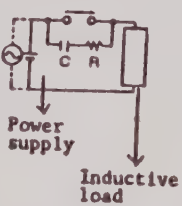
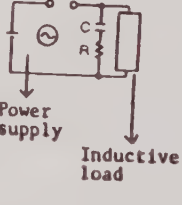
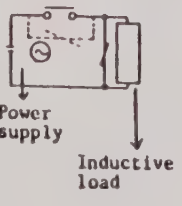
Fig. 2-7 Driving a High Current Inductive Load

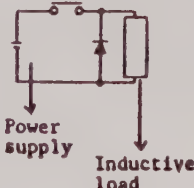
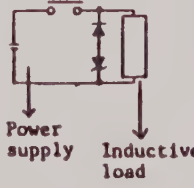
Energy accumulated in the coil is consumed in the diode by the resistance of the inductive load as Joule heat when the output turns from ON to OFF. Delay will be met for the restoration time until the energy becomes the load retention force. The delay time is determined by the value of "L", resistor value, and retention force. If this delay time is a problem as a result of actual measurement, a load should be driven via a magnet switch. This makes the value relatively smaller than using a solenoid valve and it improves the response time.

7.) Surge Supression

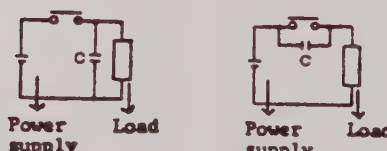
It is possible to generate several thousands volts opening and closing the load; depending on the type of load. Although output surge prevention has been included in the DO-1130 and DO-1132 output modules, specific surge prevention measures may be required to protect the output transistor of the DO-1132 if the signal line to the load is too long. Since the surge prevention has not been incorporated for the Relay Output Module DO-1136, you may need to install an external surge supressor. This extends the life of contact points, prevents noise, and reduces generation of carbon by arcing and the formation of nitric acid. However, incorrect use of the arc surpressor may cause adverse effects. Also, it must be noted that the use of the arc surpressor prolongs restoration times to some degree.

Typical Arc Suppressor Examples

Circuit example		Use		Note	Choice of element
		AC	DC		
RC network method	 Power supply Inductive load Across points			*When operated under AC power, the impedance of the load should be much smaller than the impedance of the RC network. Where the load is a relay or solenoid, there may be a delay in the restoration time. When the source voltage is 24 to 48 volts, it is preferable to make installation across loads. In the case of 100 to 250 volts, installation should be made between contact points. (See diagrams)	The following may be used as approximate values: C: 1 to 0.5 (μF) for contact current of 1A. R: 0.5 to 1 (ohms) for contact voltage of 1 V. The values may not be exact depending on the nature of the load and variation in the relay characteristics. Test to make sure that C performs the discharge suppression during ON and OFF of the contact point; and that R helps to limit current. Use C that has voltage capacity of two to three times of the supply voltage. Use AC capacitor (no polarity).
	 Power supply Inductive load Across loads				
Varister	 Power supply Inductive load			With this method, voltage is limited by the constant voltage characteristics of the varister. There may be a slight delay in the restoration time. When the source voltage is 24 or 48 volts, it is preferable for more effects to make connection between loads. In the case of 100 to 250 volts, connection should be made between contact points.	Varister voltage must be as follows: 120VAC .. 220 to 290V 240VAC .. 430 to 470V

Circuit example		Use		Note	Choice of element
		AC	DC		
Diode method	 Power supply Inductive load			Energy stored in the coil is released. Heat is dissipated by the resistance of the inductive load. This method involves more delay time than the RC method.	Use a diode whose PIV rating is ten times the circuit voltage, and has a forward current rating larger than the load current. A circuit whose voltage is low, may use a diode having a PIV of two to three times the supply voltage.
Diode zener diode method	 Power supply Inductive load			Method preferred where the normal diode method causes excessive restoration time.	The zener voltage should be the same as the source voltage.

Avoid using the following suppression techniques:



Power supply

Load

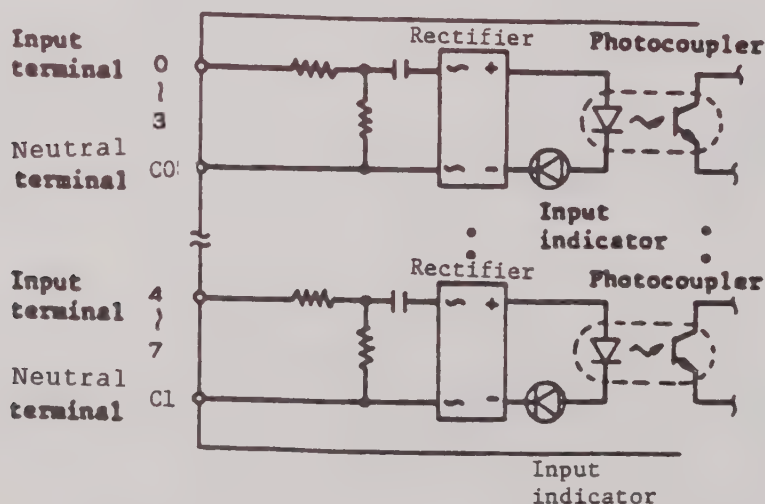
These circuits suppress an arc at shut off, but when the contact point is closed, they are likely to cause the contact point to melt as C is a virtual short circuit.

DC inductive loads are more difficult to switch (without arcing), than DC resistive loads. Using the proper arc suppression method can dramatically improve inductive circuit performance.

INPUT MODULE SPECIFICATIONS.

There are three input module types that are part of the '085 System. The specifications for each are listed below and in the following two pages.

<u>ITEM</u>	<u>SPECIFICATION</u>
AC INPUT MODULE DI-1131	(110/120VAC)
Number of inputs.....	8 points (opto-isolated), 2 groups of 4
Rated input voltage.....	110/120VAC, 50/60Hz, approx. 14mA wave
and current	distortion: 5%, maximum
Input voltage range.....	85 ~ 132VAC
ON voltage.....	85VAC, minimum
OFF voltage.....	30VAC, maximum
ON current.....	10mA, minimum
OFF current.....	3.5mA, maximum
Input impedance.....	Approx. 8.5Kohms
Turn on time.....	15ms plus scan time, maximum (at 120VAC)
Turn off time.....	30ms plus scan time, maximum (at 120VAC)
Input indicator.....	Red LED illuminates when input is "ON"
Connection terminal.....	Eleven contact terminal strips (8
	inputs, 2 commons, 1 Chassis GND)
Dielectric strength.....	1500VAC, one minute (between all input
	terminals and ground)
Insulation resistance....	10Mohms, minimum with 500 VDC meg ohm
	meter (between all input terminals and
	ground)
Weight.....	230 g (0.50 lbs.)
Current drain.....	3mA/24VDC

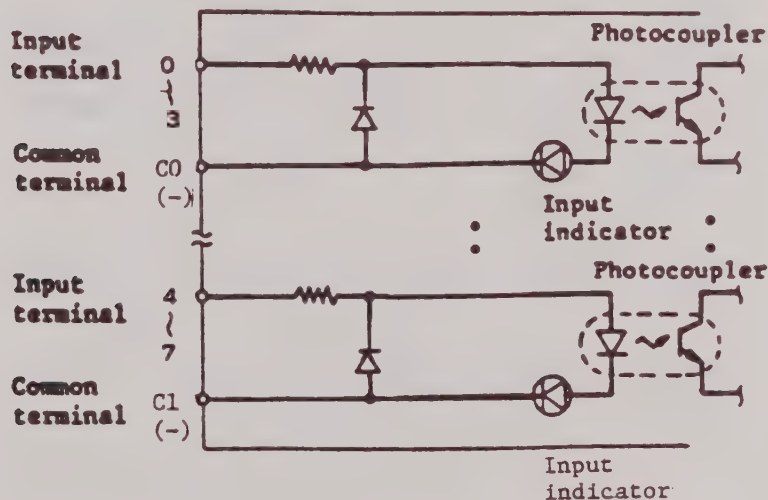


Caution: Input devices such as proximity switch and photo switch may not turn this module OFF due to their high leakage current during the OFF state.

One common terminal is provided for each four input terminals. The two common terminals for the two input groups are electrically isolated.

Input module specifications (cont.)

ITEM	SPECIFICATION
DC INPUT MODULE DI-1133	(12/24VDC)
Number of inputs.....	8 points (opto-isolated), 2 groups of 4
Rated input voltage.....	24VDC, approx. 10mA (ripple 10%, max.)
and current	12VDC, approx. 5mA (ripple 5%, max.)
Input voltage range.....	10 ~ 28VDC
ON voltage.....	10VDC, minimum
OFF voltage.....	6VDC, maximum
ON current.....	3.5mA, minimum
OFF current.....	1.5mA, maximum
Input impedance.....	Approx. 2.4Kohms
Turn on time.....	10ms plus scan time, maximum (at 12/24VDC)
Turn off time.....	20ms plus scan time, maximum (at 12/24VDC)
Input indicator.....	Red LED illuminates when input is "ON"
Connection terminal.....	Eleven contact terminal strips (8 inputs, 2 commons, 1 Chassis GND)
Dielectric strength.....	1500VAC, one minute (between all input terminals and ground)
Insulation resistance....	10Mohms, minimum with 500 VDC meg ohm meter (between all input terminals and ground)
Weight.....	208 g (0.45 lbs.)
Current drain.....	3mA/24VDC

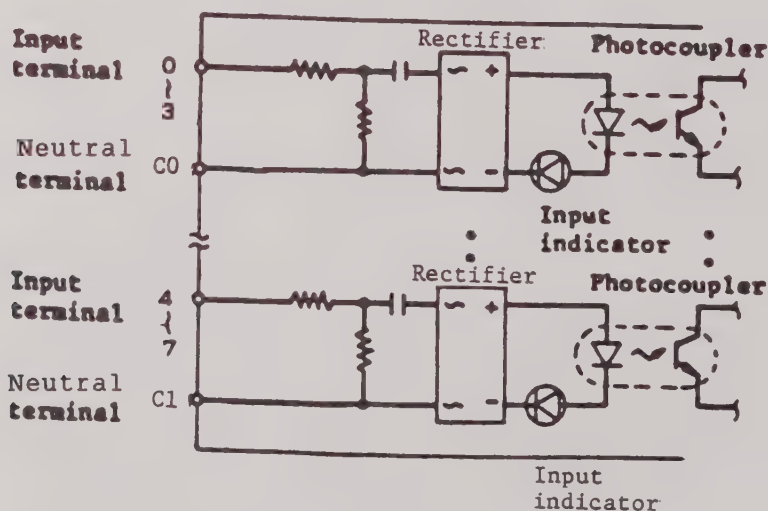


Caution: Input devices such as proximity switch and photo switch may not turn this module OFF due to their high leakage current during the OFF state.

One common terminal is provided for each four input terminals. The two common terminals for the two input groups are electrically isolated.

Input module specifications (cont.)

ITEM	SPECIFICATION
AC INPUT MODULE DI-1135	(220/240VAC)
Number of inputs.....	8 points (opto-isolated), 2 groups of 4
Rated input voltage.....	220/240VAC, 50/60Hz, approx. 14mA wave distortion: 5%, maximum
Input voltage range.....	170 ~ 250VAC
ON voltage.....	170VAC, minimum
OFF voltage.....	60VAC, maximum
ON current.....	10mA, minimum
OFF current.....	3.5mA, maximum
Input impedance.....	Approx. 17Kohms
Turn on time.....	15ms plus scan time, maximum (at 240VAC)
Turn off time.....	30ms plus scan time, maximum (at 240VAC)
Input indicator.....	Red LED illuminates when input is "ON"
Connection terminal.....	Eleven contact terminal strips (8 inputs, 2 commons, 1 Chassis GND)
Dielectric strength.....	1500VAC, one minute (between all input terminals and ground)
Insulation resistance....	10Mohms, minimum with 500 VDC meg ohm meter (between all input terminals and ground)
Weight.....	230 g (0.50 lbs.)
Current drain.....	3mA/24VDC



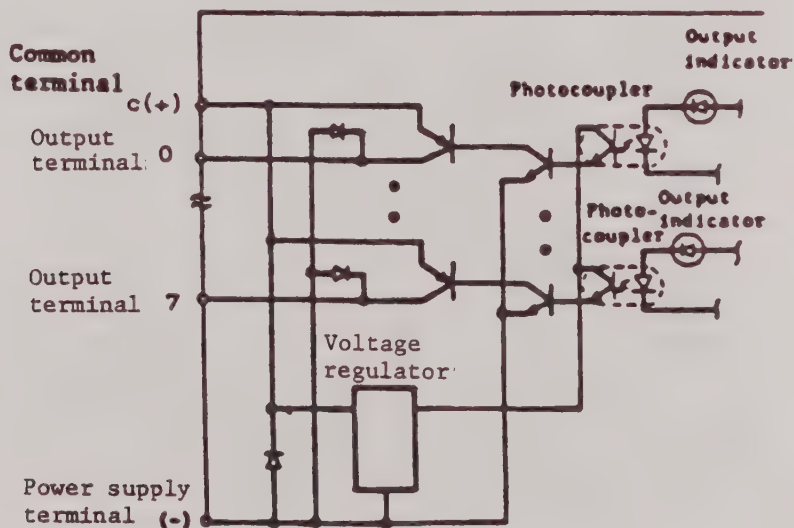
Caution: Input devices such as proximity switch and photo switch may not turn this module OFF due to their high leakage current during the OFF state.

One common terminal is provided for each four input terminals. The two common terminals for the two input groups are electrically isolated.

OUTPUT MODULE SPECIFICATIONS

There are three output module types that are part of the '085 System. The specifications for each are listed below and in the following pages.

<u>ITEM</u>	<u>SPECIFICATION</u>
DC OUTPUT MODULE DO-1132	(12/24VDC)
Number of inputs.....	8 points (opto-isolated), 2 groups of 4
Output device.....	Transistor (sourcing)
Rated output voltage.....	12/24VDC
Output voltage range.....	10 ~ 28VDC
Maximum rated output.....	1 Amp DC/point, 2 Amps DC/group
current	
Maximum surge current....	6 Amps for 10ms (output element characteristics)
Maximum leakage current..	0.1 mA (off state)
Maximum voltage drop.....	1.5V @ 1A load)
Turn on/off time.....	1ms plus scan time, maximum (for resistive load)
Output indicator.....	Red LED illuminates when output is "ON"
Connection terminal.....	Eleven contact terminal strips (8 outputs, 1 chassis GND, 1 power (+), 1 power (-))
Weight.....	266 g (0.58 lbs.)
Current drain.....	61mA/24VDC



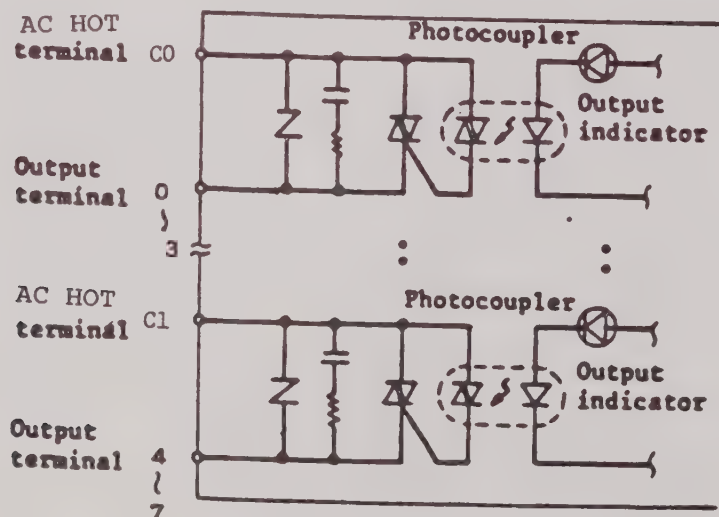
Caution: Heavy inductive loads may cause the ON to OFF response time to exceed 1 second.

Output terminal 0~3 are one group, and 4~7 are the other group.

One common terminal is provided for eight output terminals.

Output module specifications (cont.)

ITEM	SPECIFICATION
AC OUTPUT MODULE DO-1130	(110/120VAC, 220/240VAC)
Number of outputs.....	8 points (opto-isolated), 2 groups of 4
Output device.....	Triac
Rated output voltage.....	110/120VAC, 220/240 VAC, 50/60Hz, wave distortion: 5%, maximum
Output voltage range.....	15 ~ 250VAC
Maximum rated output.....	1 Amp AC/point, 2 Amps AC/group
current	
Maximum Surge Current....	60 Amps for 1 cycle (output element characteristics)
Maximum leakage current..	3mA at 250VAC, 50/60 Hz, sine wave (off state)
Maximum voltage drop.....	1.6V at 1 Amp load (on state)
Turn on time.....	1ms plus scan time, maximum
Turn off time.....	10ms plus scan time, maximum
Output indicator.....	Red LED illuminates when input is "ON"
Connection terminal.....	Eleven contact terminal strips (8 inputs, 2 commons, 1 Chassis GND)
Dielectric strength.....	1500VAC, one minute (between all output terminals and ground)
Insulation resistance....	10Mohms, minimum with 500 VDC meg ohm meter (between all output terminals and ground)
Weight.....	282 g (0.62 lbs.)
Current drain.....	117mA/24VDC



Caution: Light loads (such as neon lamps and low current relays) may not turn off due to leakage current rating of 3mA.

Output terminal 0~3 are one group, and 4~7 are the other group.

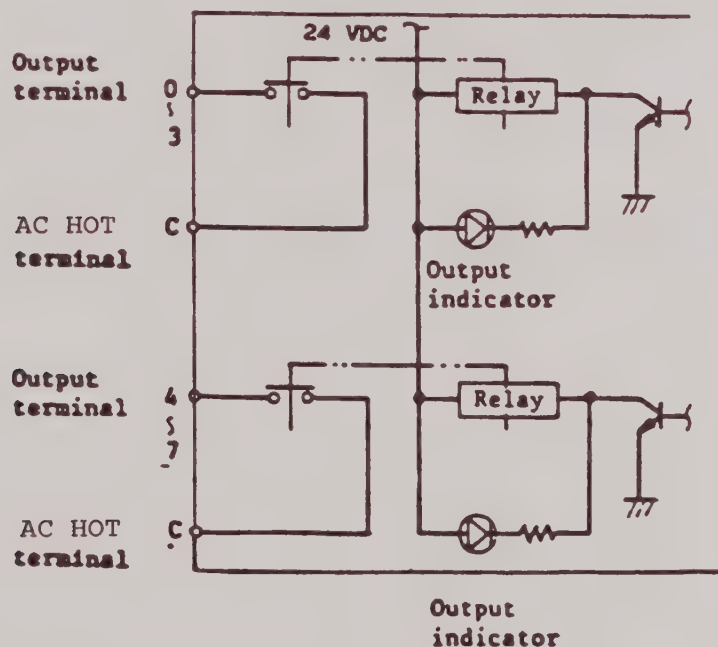
One common terminal is provided for each four output terminals. The two common terminals for the two output groups are electrically isolated.

Output module specifications (cont.)

ITEM
RELAY OUTPUT MODULE DO-1136

SPECIFICATION

Number of outputs.....	8 points (relay isolation), 2 groups of 4
Output device.....	Relay (one normally open contact)
Output voltage range.....	5 ~ 250VAC
	5 ~ 50VDC
Maximum rated output.....	NOTE 1
current	
Life.....	Electrical: 100,000 times (@30 /min.)
	Mechanical: 10,000,000 times (@300 /min.)
Turn on/off time.....	15ms plus scan time, maximum
Output indicator.....	Red LED illuminates when input is "ON"
Connection terminal.....	Eleven contact terminal strips (8 inputs, 2 commons, 1 GND)
Dielectric strength.....	1500VAC, one minute (between all output terminals and ground)
Insulation resistance....	10Mohms, minimum with 500 VDC meg ohm meter (between all output terminals and ground)
Weight.....	292 g (0.64 lbs.)
Current drain.....	171mA/24VDC



Caution: After a contact drives a heavy load, it may not drive a light load.

Output terminal 0~3 are one group, and 4~7 are the other group.

One common terminal is provided for each four output terminals. The two common terminals for the two output groups are electrically isolated.

NOTE 1

Maximum rated output:

2 Amp/point	120/240 VAC - at resistive load
	30 VDC - at $L/R < 7\text{ms}$
0.5 Amp/point	120/240 VAC - at .4 power factor
	30 VDC - at $L/R > 7\text{ms}$
	60 VDC - at $L/R < 7\text{ms}$
0.2 Amp/point	60 VDC - at $L/R > 7\text{ms}$

CHAPTER 3. INSTALLATION.

UNPACKING.

Unpack the contents of each container and examine the modules for any physical damage that might have occurred in shipment. Compare the inventory of shipped materials to the packaging invoice to insure that the shipment is complete. Contact Gould Customer Service if problems of any nature need to be resolved.

MOUNTING/DISMOUNTING MODULES ON A DIN RAIL.

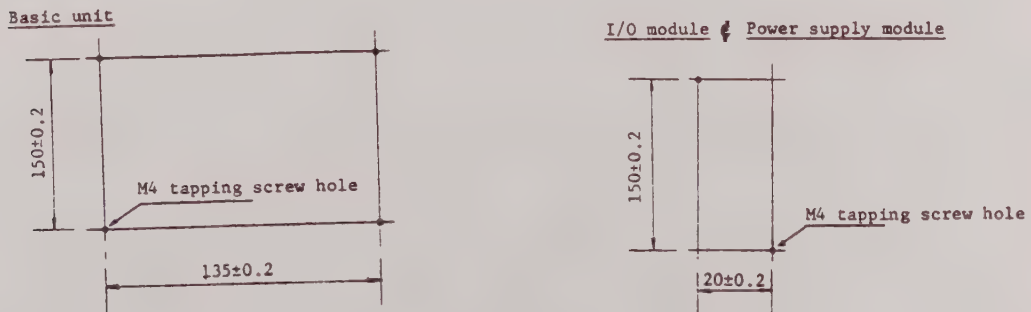
Each module of the GOULD '085 System can be mounted on a commercially available universal steel DIN rail. To mount, simply place the mounting notch lip (on the rear surface of the module) over the top of the rail, and push the module until it is fully seated. To remove the module from the rail, push down on the locking tab underneath the module with a screwdriver and swing the bottom upward.

Noise immunity is enhanced by connecting the base plate of the modules to Earth ground. If the system is installed in a high humidity area, rusting of the DIN rail may occur impeding proper conductivity. In such a case it is recommended that the system be directly installed on the factory control panel or grounded to it where the system is located as close as possible (not farther than 36 inches), and the grounding cable is sufficiently heavy.

Avoid using aluminum DIN rails as they are alumite treated and have a less than desirable grounding conductivity. If aluminum must be used then as above, locate the system close to a solid Earth ground and use a heavy grounding cable.

MOUNTING DIRECTLY TO A PANEL.

The diagram below shows the dimensions required for drilling screw holes.



All dimensions are in MM.

Figure 3-1. Installation Dimensions

PE-0001 POWER SUPPLY INPUT VOLTAGE SELECTION.

The Power Supply is used to supply the '085 Controller with +24Vdc. Applied source power can be either 110/120 Vac or 220/240 Vac as selected by the slide switch on the power supply. The switch has been factory set to 115 Vac. To change the switch setting:

- a. Shut off source power to the power supply.
- b. Loosen the two screws above and below the selector switch. DO NOT REMOVE THEM.
- c. Change switch selection.
- d. Tighten screws

WIRING THE '085 SYSTEM.

The '085 system is wired as shown in Figure 3-2. As shown, all connection pairs should be twisted pair wires. The AC input power wire to the PE-0001 Power Supply should be AWG 16 or heavier. DC power wires connecting the Power Supply to the PC-0085 Controller should be no lighter than AWG 20.

The terminal blocks on both the Power Supply and the Controller have a clear plastic cover. To remove or replace, squeeze the ends together bowing the cover just enough to remove or insert tabs into slots on module front panel above and below each terminal block.

WARNING

Ensure that the covers are replaced after wiring.

Observe the following precautions when wiring the system:

1. Install the power supply and I/O signal lines away from other high voltage lines.
2. Route all wires so as to allow easy removal and installation of the I/O modules.
3. Use stranded wire greater than .05 MM² cross sectional area when wiring from an intermediate terminal board to an input module.
4. For output devices that require larger current (such as a solenoid valve), use stranded wire greater than 0.75 MM² cross sectional area when wiring from an intermediate terminal board to an output module. Use stranded wire greater than .05mm² thick for smaller current.

Cautionary Notes (cont.)

5. Use wire 1.25MM^2 cross sectional area when wiring from an intermediate terminal board to external I/O devices.
6. If a suitable earth ground is not available because the entire factory has a voltage potential on ground sources, connect the ground terminal to the chassis ground on the '085 System.
7. The FG (chassis gnd) terminal of the '085 System must be connected as shown below. The FG terminal of the Power Supply and Controller must be connected to ground terminal by Earth Gnd. The FG terminals of the I/O must be interconnected with a metal strip available as an ancillary item to the '085 system. Connect the last I/O in the chain to an Earth Gnd.

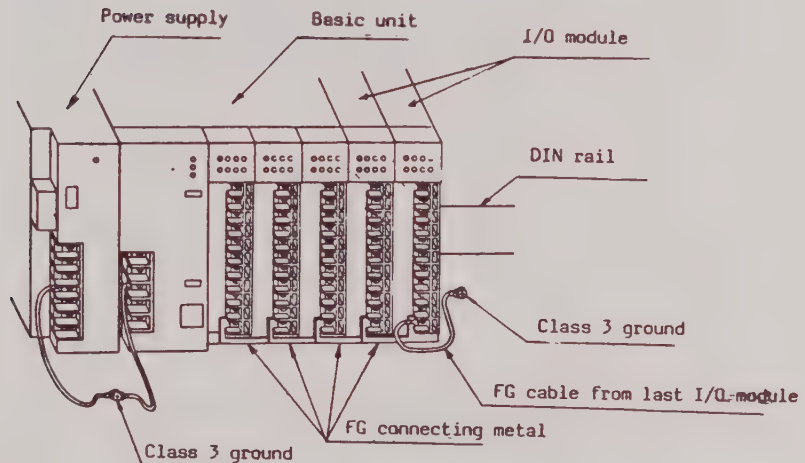
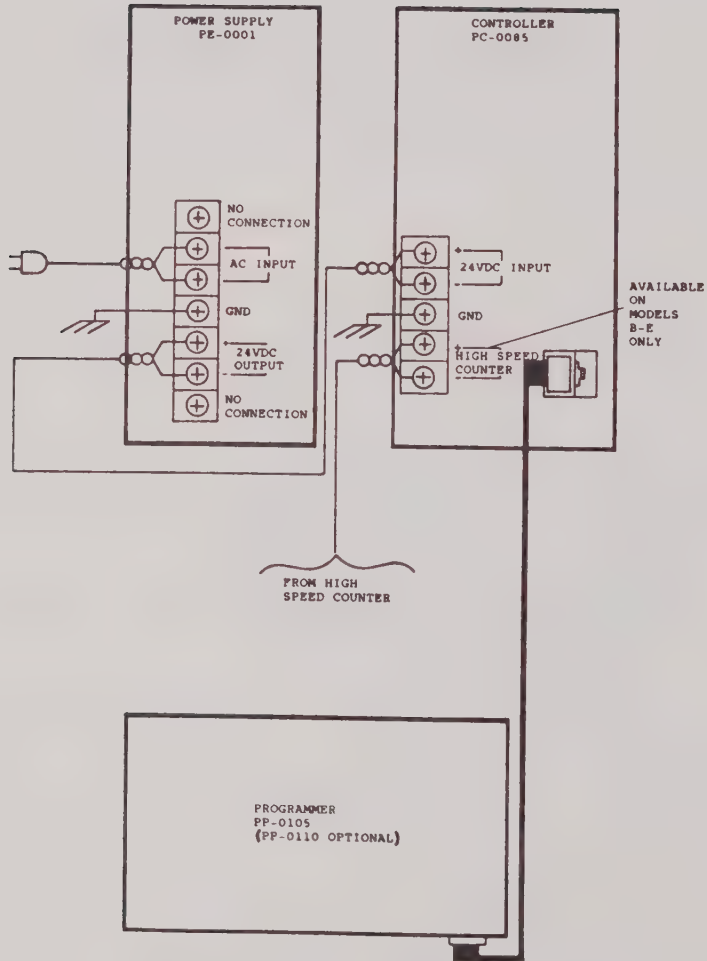


Fig. 3-2. Wiring the '085



BATTERY INSTALLATION /REMOVAL.

A battery is supplied with the PC-0085 Controller. Although it has been factory installed, it may need to be replaced if after power up the FAULT indicator lights, yet the Controller operates correctly and the RUN indicator lights properly. Replace the battery as follows:

1. Remove the cover of the of the Controller module by pressing the mounting tabs until they release from slots.
2. Remove the battery to be replaced by disconnecting the 4 pin connector. Slide battery out.
3. To install a new battery, reverse the procedure. The connector is keyed to prevent a mis-connection.

CAUTION

Exercise extreme care when replacing the battery if an AC input or output module is installed immediately adjacent to the Controller. Although you can remove and install the battery with the power on, it is recommended that power be removed for safety purposes.

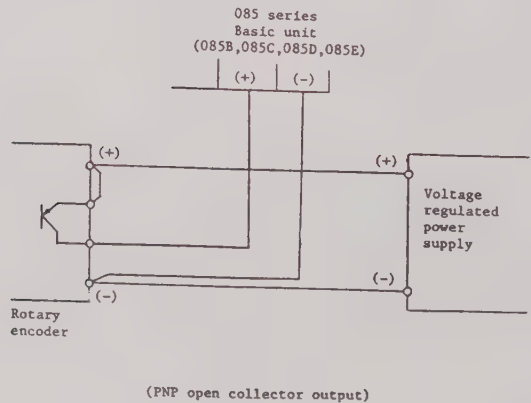
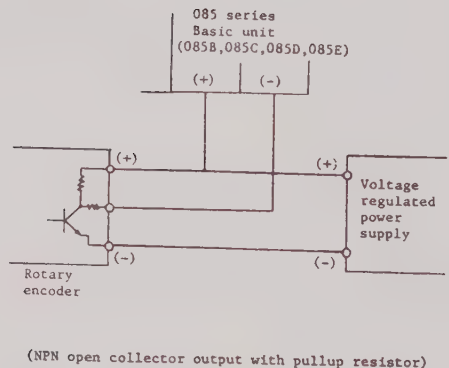
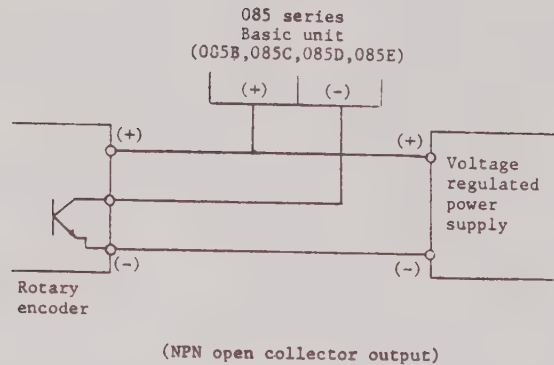
CONNECTING HIGH-SPEED COUNTERS (models w/ suffix B ~ E only)

High-Speed counting devices (ie; rotary encoders) can be connected to the '085 System models B, C, D, and E. Counting device specifications should be in accordance with the following:

Supply Voltage	: 12Vdc +/-10%, or 24Vdc +/-10%
Output Waveform	: Square wave with minimum pulse-width of 100 usecs.
Output Signal	: Single Phase
Output Circuit	: Open collector type

The encoder must be capable of current sinking more than 30 mA (12/24 Vdc). If a voltage type of encoder is used that employs a current limiting resistor at it's output, use either a current amplifier or remove the current limiter if the counter of the Controller will not count applied counter signals.. Figure 3-2 shows configuration of encoder to the '085.

Figure 3-2. Connecting a High Speed Counter



INSTALLING I/O.

CAUTION

Insure that the power is OFF to the controller before installing/removing I/O.

To install I/O modules into the basic unit housing, open the top ribbon-cable cover. Slide the I/O module into the slot until mounting tabs seat. Connect into the I/O daisy chain cabling. Replace top ribbon-cable cover.

To remove I/O modules from the basic unit housing, open the top ribbon-cable cover. Remove the ribbon-cable connectors (and the loopback connector if last I/O in the chain). Pinch the mounting tabs on the I/O module and slide the I/O out.

GOULD PC-0085 models B ~ E are I/O expandable. Each of the additional I/O modules can be mounted on the same DIN rail as the Controller. By squeezing with your fingers each top ribbon-cable connector cover, remove the topcover for each interconnection to be made. From the current last I/O in the chain, remove the loopback connector. Interconnect the additional I/O with the ribbon cable links, as supplied, in a daisy chain. REPLACE THE LOOPBACK CONNECTOR TO THE LAST I/O MODULE CONNECTOR IN THE CHAIN. Each ribbon cable link will fit neatly in a notch on the top sidewall of each unit.

CAUTION

Do not twist cable links or attempt to force the keyed connectors to fit to the jacks or malfunction will result.

As shown in Figure 3-3, replace the top cover by lightly squeezing the ends together and snapping into place.

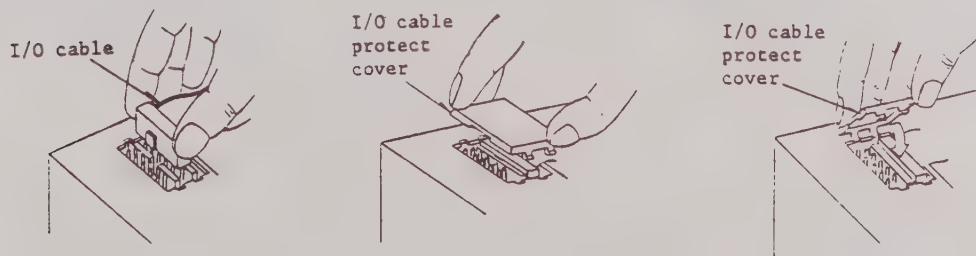


Figure 3-3. I/O Ribbon Cable Connection

INSTALLING THE PP-0105 PROGRAMMER.

Mounting the Programmer to the Controller

As shown in Figure 3-4, the PP-0105 Programmer can be mounted to the PC-0085 Controller. A programmer attachment adapter is included with the Programmer and is inserted into the slots on the front of the Controller. The Programmer can then be attached by mounting the Programmer to the attachment adapter as shown and sliding to the left.

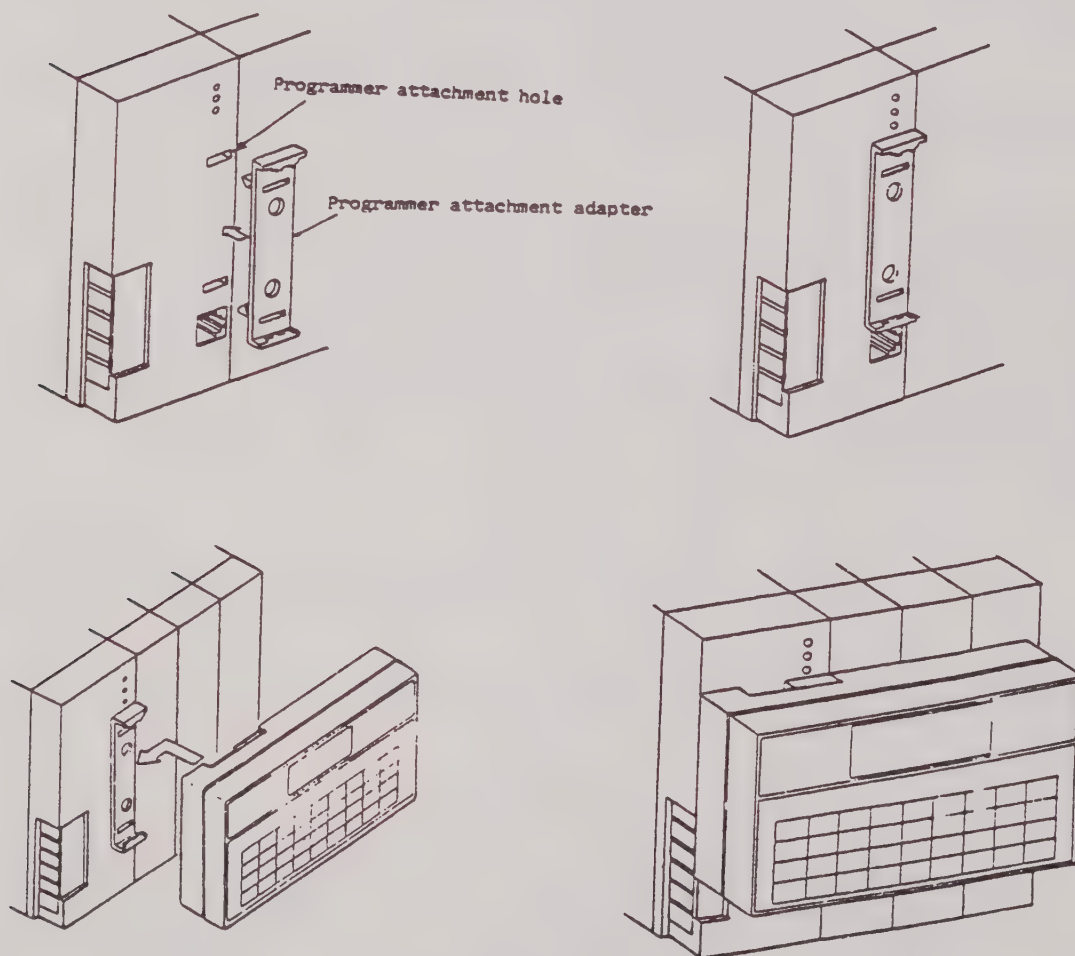
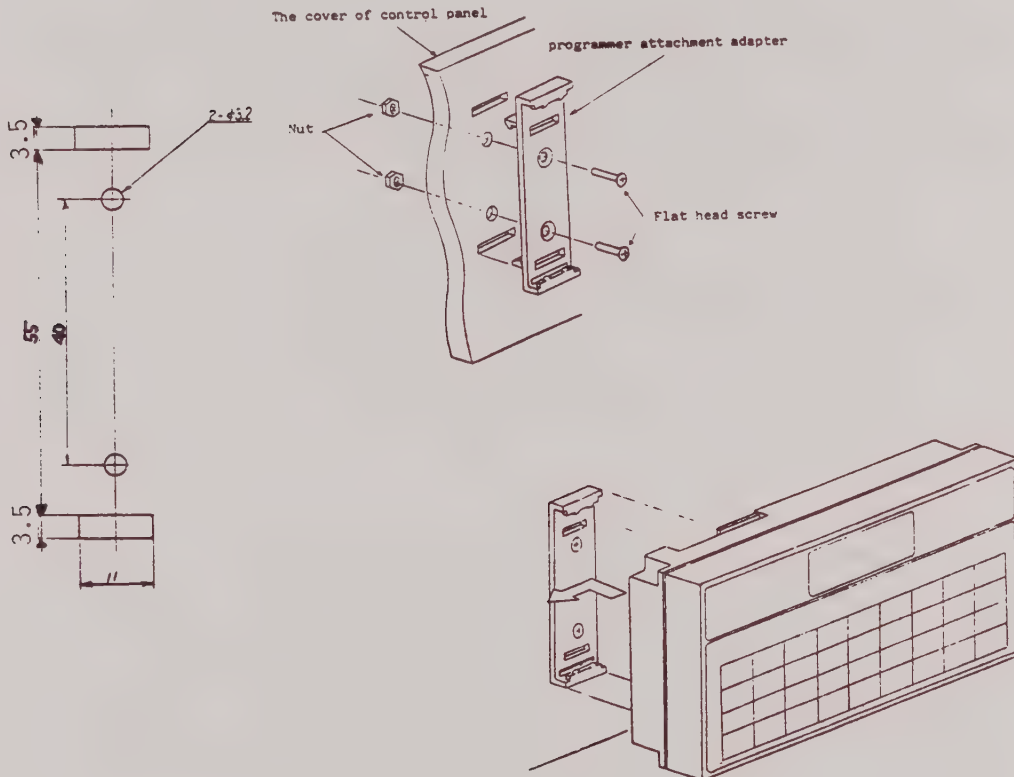


Fig. 3-4 Mounting the Programmer to Controller

Mounting the Programmer to a Panel.

To mount the programmer to a control panel or inside a cabinet wall, make the mounting holes as indicated by the dimensions in Figure 3-5 below. Using two #4 flathead screws, washers, and nuts mount the programmer attachment adapter to the panel. The PC-0105 Programmer is mounted to the panel adapter as shown below:

Figure 3-5. Mounting the Programmer to a Panel.



Connecting the Programmer to the Controller

Connect the Programmer to the P105 PORT on the Controller with the supplied cable. The cable connector is keyed to fit one way, do not attempt to force fit. Make sure that the cable is fully seated and that the locking tab is in place.

To Remove the Programmer/Controller Connector Cable, firmly press the locking tab and pull the connector from the jack.

SYSTEM DESIGN CONSIDERATIONS AND SAFETY

The main difference between a PC and a conventional relay circuit is that the PC handles the control program in a cyclic manner (serially), while the relay circuit processes in parallel.

CAUTION

The PC's programming elements should not include any critical components. Your application must provide fail-safe mechanisms that are independent of the PC's program.

The circuits described below should be established outside the PC:

- Emergency stop circuit
- Protective circuits
- High voltage operating circuits
- Other circuits that prevent human injury and/or mechanical failures

The response time of the PC must be considered when making fail safe plans.

CAUTION

The PC 0085 Controller is configured in the factory with all outputs in the retentive state. This means that if an output is ON when a logic scan stops (changing from RUN mode to STOP mode via the programmer, or if there is a diagnostic failure), it will remain ON. In some applications this may be undesirable or dangerous. The control system designer is responsible for PC operation and safety. There are two methods of making all outputs non-retentive.

1. To turn all of the outputs OFF when the scan stops set system address #203 to 001.

Procedure: Press keys as in the sequence shown

* * PROG MODE SET/8 CLEAR SYS MEM 203 MNTR CONV 001 ENTER

On the following page, other safety considerations are shown.

Safety Considerations

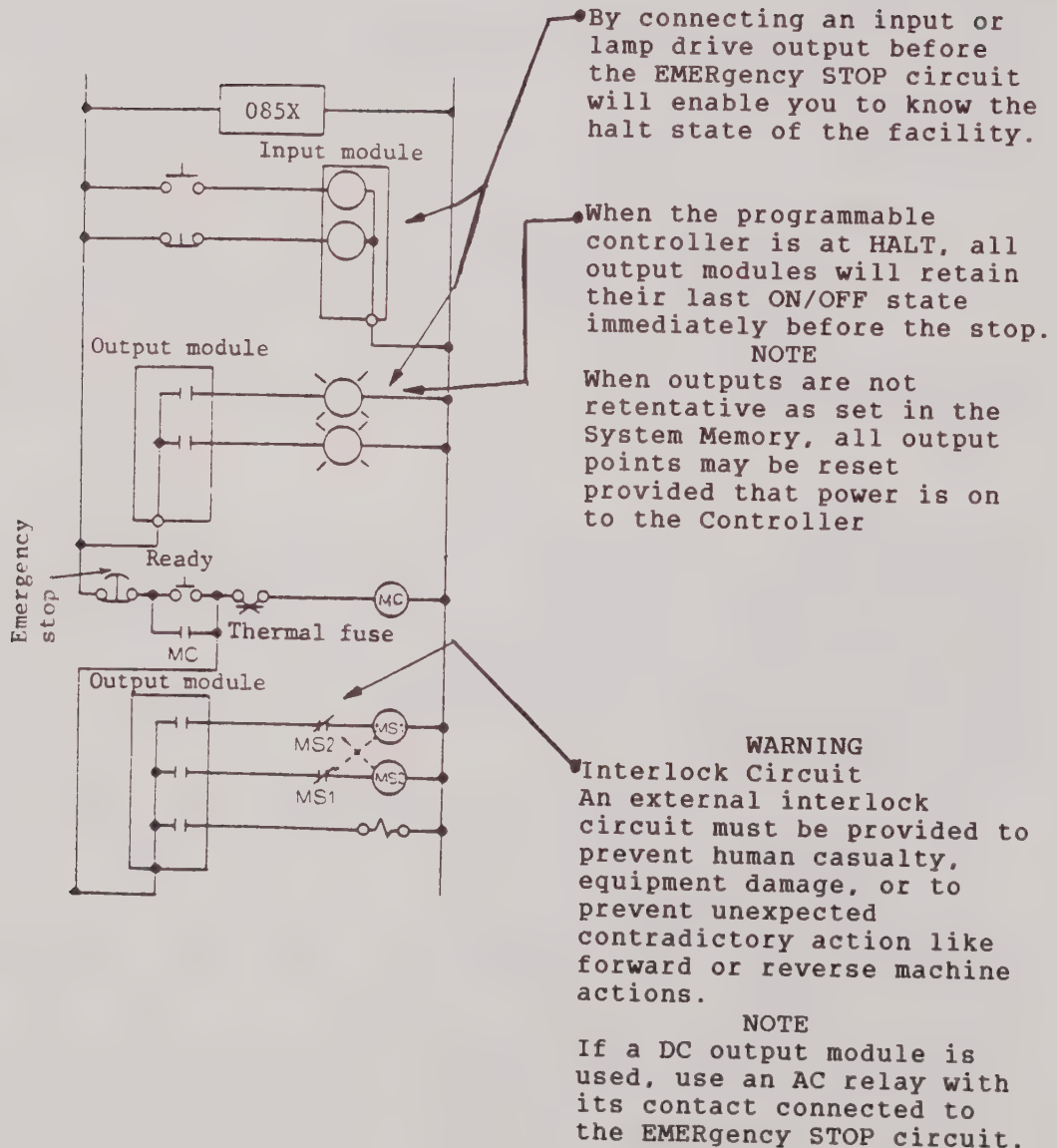


Fig. 4-1 Safety Considerations

SECTION 1 OPERATION

The figure below illustrates the PP-0105 Programmer.

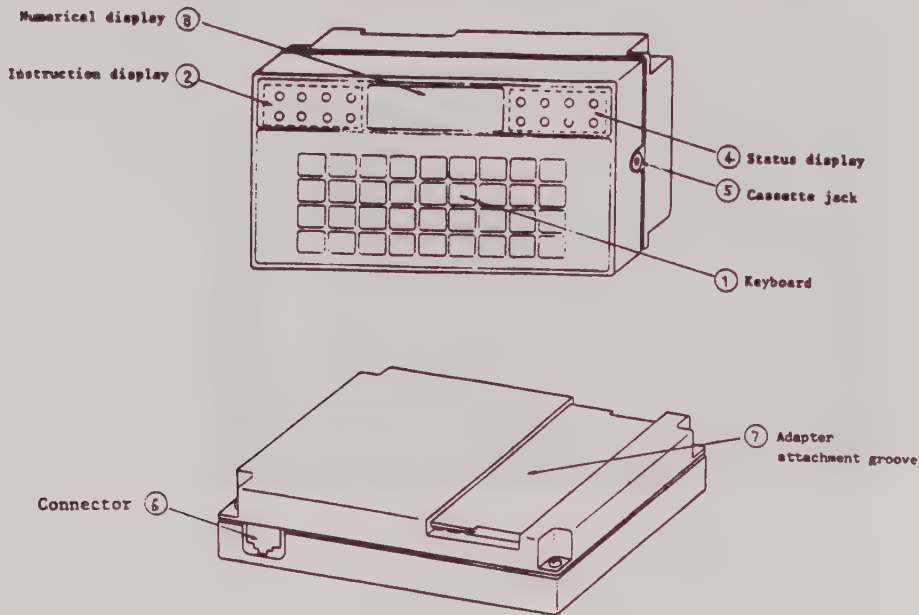


Fig. 4-2 PP-0105 Programmer

1. Keyboard
Used for an entry of program and monitoring operation.
2. Instruction display
3. Numerical display
Instruction or data is displayed keyboard control.
4. Status display
Operational state of the machine is indicated on this display.
5. Cassette jack
Used for connection of the cassette tape recorder to which the program is saved or from which program is loaded to the memory.
6. Connector
This connector interfaces to the control unit.
7. Adapter attachment groove
When the programmer is attached directly to the basic unit, the adapter (accessory of the programmer) should be attached to the groove.

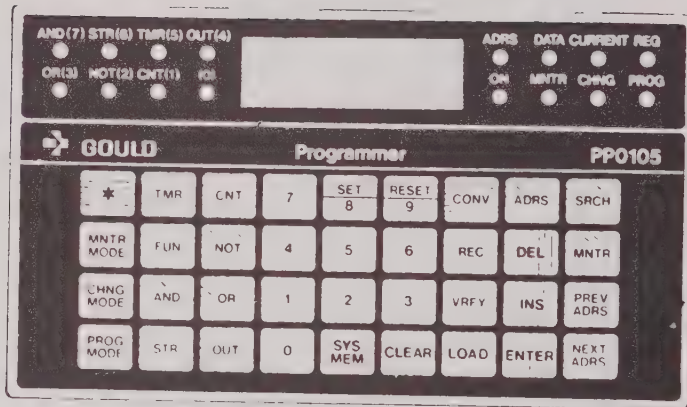


Fig. 4-3 PP-0105 Programmer Keyboard

Audible Alarm

The PE-0105 features an audible alarm that is user selectable. The alarm when selected will sound at every key depression advising the operator that data has been entered. The alarm will also sound twice if an illegal entry has been tried. This feature is not selectable however. Thus, the operator is constantly advised to the "legality" of the keystroke entries whether the alarm is selected or not.

To select/deselect the alarm press:

*	*	1	SET/8	(= ON)
*	*	1	RESET/9	(= OFF)

Upon power-up or connection of the programmer, the alarm mode is always ON (default condition).

The Display

The programmer display is shown below:

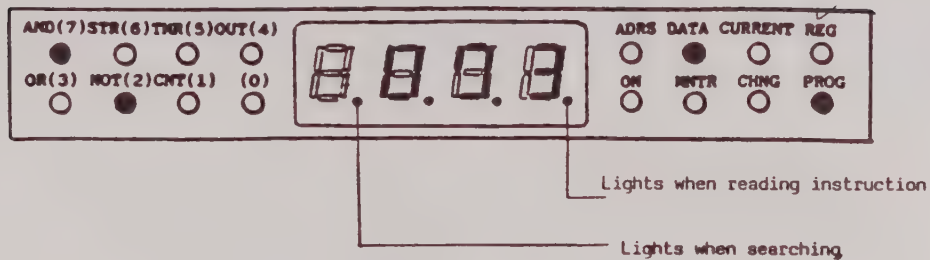


Fig. 4-4 Programmer Display

16 red LED's indicate mode, status and other data as listed below, and the 4 red seven-segment LED's display numbers.

<u>LED</u>	<u>Description</u>
PROG	Lights when in Program Mode
CHNG	Lights when in Change Mode
MNTR	Lights when in Monitor Mode
ON	Lights when the monitored relay or coil is ON
REG	Lights when data is written to a register or register is number is set for monitoring.
CURRENT	Lights when monitoring system memory or current value of the TMR, CNT, or a register
DATA	Lights when displayed number of the numerical display is a data value and not an address

Programmer Modes of Operation

There are three modes of operation: PROGRAM, MONITOR, and CHANGE. Use the following key strokes to enter the desired operational mode. The respective LED indicator on the keyboard will light to indicate the current mode of operation.

PROGRAM	*	*	PROG MODE	8 SET
MONITOR	*	*	MNTR MODE	8 SET
CHANGE	*	*	CHNG MODE	8 SET

Functions of Modes

Mode	Controller State	Controller RUN Indicator	Functions
PROGRAM	Stop	Blinking	1. Specification setup (write to system memory) a. Change retentive relay area. b. Choice of TMR reset at power interrupt c. Choice of CNT reset d. Choice of output reset at PC failure 2. Memory Clear 3. Enter, insert, or delete an instruction 4. Search data memory for instruction 5. Sequentially read instructions 6. Program check 7. Parity check 8. Tape recorder operations (load, record, verify)

(continued on next page)

Functions of Modes (Cont.)

Mode	Controller State	Controller RUN Indicator	Functions
MONITOR	Run	Steady ON	1. Read an instruction
			2. Read relay's ON/OFF state
			3. Read current TMR, and CNT value
			4. Read in current register value
			5. Tape recorder operation and data memory
			6. Search an instruction and data memory
CHANGE			7. Set/reset retent relays
			8. Set/reset TMR and CNT
			9. Change preset values
			10. Change constant
			11. Change register value

NOTE: Items 1 through 6 above are applicable only in the MONITOR mode. Items 1 through 11 are applicable in the CHANGE mode.

THE PROGRAM MODE

Prior to programming, the PC must be set into the Program Mode by pressing the keys in the sequence below:

* * PROG 8
 MODE SET

When the PC is in the Program mode, the PROG indicator on the controller will light.

Addressing

To specify an address to read from and write to, to insert or delete the contents of, or to search:

1. Press CLEAR
2. Push the ADRS key
3. Enter the desired address key on the programmer using keys 0 thru 7. (The address of the 085 system are octal, therefore there are no addresses with digits of 8 or 9.)

After each key entry, the address on the display of the programmer shifts one digit to the left. When the address exceeds the addressing range of the system, the high order digits turn to 0's and the last key entry becomes the new address on the display.

Addressing range for the '085 System is 0000-1637 (octal).

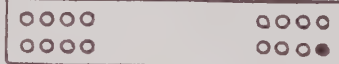
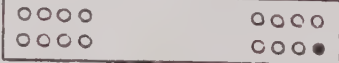
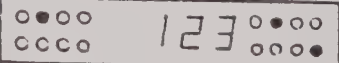
Key operation	Display	Note
		Display is cleared.
		
		
		
		
		
  		
		Display is cleared.
   		Address entered.
		The contents of the address 0267.
		Data memory number changed.

Fig. 4-5 Addressing Example

When a numeric key is pressed instead of the ADRS key (while the contents are being displayed, it will be interpreted by the system as a data memory number.

Program Memory Clear

The entire program area is padded with NOP instructions and an END command is written into the last address. The entire data memory area will be reset to 0's when cleared.

Key operation	Display	Note
		This operation is required even in the PROGRAM mode. There would be no change in the display.
		Memory clear has completed.
		Memory clear error

Fig. 4-6 Memory Clear Example

System Memory Clear

To set the system memory into its initial state, enter the following keystrokes

Key operation	Display	Note

Fig. 4-7 System Memory Clear Example

In case of a system memory clear error, the following is displayed.

Fig. 4-8 System Memory Clear Error Display

System Memory Address Designation

Any system memory address within a range 000 - 377 can be entered in the following manner to read the contents of that address or to write to it.

1. Press CLEAR
2. Press SYS/MEM. Address 000 will be displayed.
3. Press any numeric key 0-7 to specify the desired address.

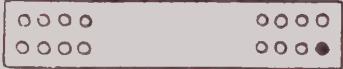
Key operation	Display	Note
		Display is cleared.
		
  		Address #200 is set.

Fig. 4-9 System Memory Address Designation Example

Instruction Keys

Except for STR, NOT, TMR, and CNT which are used in conjunction with another key, all command keys are handled where the last entry is valid. The corresponding LED indicator lights on the Programmer.

AND Instruction +  → AND STR Instruction
OR OR STR

STR AND Instruction +  → STR NOT Instruction
OR AND NOT OR NOT

STR (NOT) AND (NOT) +  → STR (NOT) TMR Instruction
OR (NOT) OR (NOT) TMR

STR (NOT) AND (NOT) +  → STR (NOT) CNT Instruction
OR (NOT) OR (NOT) CNT

Program Entry and Verification

There are three ways to enter a program as shown below. Remember that you must be in PROG mode to enter your program.

1. From address 000

Clear → Instruction → Enter → Next
ADRS

Instruction → Enter → Next
ADRS

ETC.

2. From specific address

ADRS → Number → Instruction → Enter → Next
ADRS

Instruction → Enter → Next
ADRS

ETC.

3. From an address where no program is written:

Clear → SRCH → MNTR → Instruction → Enter → Next
ADRS

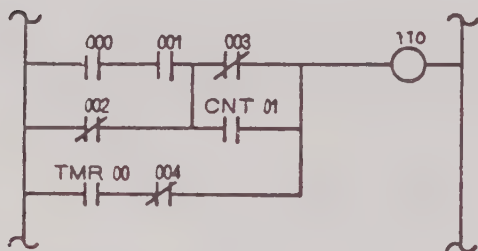
Instruction → Enter → Next
ADRS

ETC.

Note

Program verification is highly recommended prior to implementation of the '085 System as the Controller will run an incorrect program with unknown results..

Example of writing program (1)



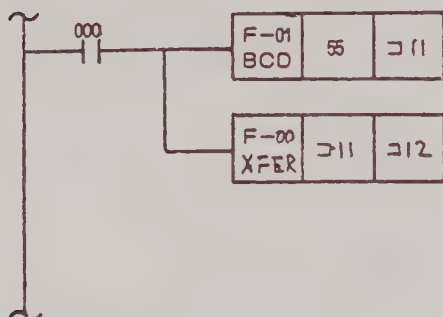
Instruction		
STR		000
AND		001
OR	NOT	002
STR	NOT	003
OR	CNT	01
AND	STR	
STR	TMR	00
AND	NOT	004
OR	STR	
OUT		110

Key operation	Display	Note
CLEAR SRCH MMTR	0000 0000 0000 . 0000	Procedure to enter from the address where no program is stored.
STR ENTER	0000 0000 0000 000.	Enter STR 000.
NEXT ADRS AND 1 ENTER	0000 0000 0000 001.	
NEXT ADRS OR NOT 2 ENTER	0000 0000 0000 002.	NOT must follow OR.
NEXT ADRS STR NOT 3 ENTER	0000 0000 0000 003.	
NEXT ADRS OR CNT 1 ENTER	0000 0000 0000 01.	
NEXT ADRS AND STR ENTER	0000 0000 0000 . 0000	
NEXT ADRS STR TMR ENTER	0000 0000 0000 00.	
NEXT ADRS AND NOT 4 ENTER	0000 0000 0000 004.	
NEXT ADRS OR STR ENTER	0000 0000 0000 . 0000	
NEXT ADRS OUT 1 1 0 ENTER	0000 0000 0000 110.	

Fig. 4-10 Programming Example

Before pressing ENTER, look at the display to ensure correct entry has been made for the instruction and data number. Since the data address is incremental only after pressing NEXT/ADRS you can change the instruction after pressing ENTER by entering the correct instruction and pushing the ENTER key again.

Example of writing program (2) Application instruction



Instruction	
STR	000
F-01	55
	11
F-00	11
	12

Key operation	Display	Note
CLEAR SPCH MNTN	0000 0000 0000 .0000	
STR ENTER	0000 000. 0000 0000	
NEXT ADRS FUN	0000 F00 0000 0000 0000	(When F-01 has been entered, a BCD constant 00 is stored in the next step and 100 in the step that follows.
1 ENTER	0000 F01 0000 0000 0000	
NEXT ADRS	0000 00. 0000 0000 0000	Reads the BCD constant stored in the preceding step.
5 5 ENTER	0000 55. 0000 0000 0000	The BCD constant (00~99) is set.
NEXT ADRS	0000 1.00. 0000 0000 0000	
1 1 ENTER	0000 1.11. 0000 0000 0000	111 (0110 - 0117) is used for the register area.
NEXT ADRS FUN ENTER	0000 F00. 0000 0000 0000	The procedure to perform transfer between registers.
NEXT ADRS 1 1 ENTER	0000 1.11. 0000 0000 0000	
NEXT ADRS 1 2 ENTER	0000 1.12. 0000 0000 0000	

Fig. 4-11 Programming Example with Application Instructions

Reading the Program

There are two ways to read the program contents. One is to read the program after specifying a starting address. The other is to use the search instruction and data memory.

Checking by specifying a starting address:

- a. Push the CLR key.
- b. Press the ADRS key.
- c. Enter the memory address to be read.
- d. Push the MNTR key. The program contents of the specified address are displayed.
- e. To continue reading, press the NEXT ADRS key to increment or press the PREV ADRS key to decrement the address.

Address	Instruction
0000	STR 000
0001	AND 001
0002	AND NOT 002
0003	AND 003
0004	OUT 200
0005	STR 000
0006	TMR 00
0007	0010
0010	STR 247
0011	AND 250
0012	STR 010
0013	OR 011
...	
1635	
1636	
1637	F-40

Fig. 4-12 Program Example

Key operation	Display	Note
1 0		Set address 0010
		Read the contents of address 0010.
		Read the contents of next address.
		When reading instruction, this LED stays on. Indicate the address of the instruction
		Indicate the contents of the address again.
		When the key is depressed with the contents of the address 0000 on display, it makes the contents of last address displayed.
		When the key is depressed with the contents of last address on display, it makes the contents of address 0000 displayed.

Fig. 4-12 Program Example (cont.)

System Memory Read and Write

The system memory can be read as follows:

1. Press CLEAR
2. Press SYS/MEM
3. Press numeric keys 0-7 to specify the address
4. Press MNTR to display the contents of the desired address

NOTE

Each time the CONV key is pressed, the display changes from hexadecimal to decimal to binary (bit pattern) to system memory address and back to hex again.

5. Press NEXT/ ADRS to increment the address on the display.
Press PREV/ ADRS to decrement the address displayed.

Writing to system memory

The following describes the procedure to write to the system memory.

1. Use the steps listed above to get to the address where entry is to be made.
2. Press numeric keys 0-7 to enter data.
- 3.) Press ENTER to store the data in the memory.

Below is an example of reading and writing to the system memory. This example shows when the retentive relay area is changed from its initial state of 600 - 647 and enlarged to 540 - 647.

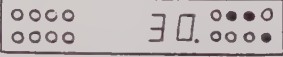
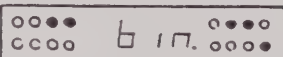
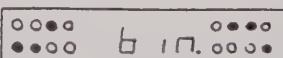
Key operation	Display	Note
		Display is cleared.
		
  		System memory address is set.
		The address is displayed in the hexadecimal mode in the first place.
		Convert to decimal
		Convert to bit pattern
      		
		

Fig. 4-13 Writing to System Memory Example

Program Search

A search function is provided to find the address where a particular instruction or data memory exists. This is very convenient in correcting the program.

Any instructions and/or data memory can be searched:

000 - 107	Input Relay
110 - 167	Output Relay
170 - 577	Auxiliary Relay
600 - 647	Retentive Relay (650-717 are Special Relays)
00 - 57	TMR, CNT
] .00 -] .71	Byte address, 000 -717 are handled as registers.

Search direction and keystrokes

Address incrementing direction: SRCH MNTR

Address decrementing direction: SRCH PREV/ADRS

Repeat the procedure to continue searching.

Search function is operational in the MONITOR and CHANGE modes.

Instruction Search

The following describes the procedure to search for a specific instruction for any direction from any address.

1. Press CLEAR
2. Enter the searching starting address.
3. Enter the instruction to be searched.
4. Press SRCH
5. Press the MNTR key to search to ending address in an incrementing direction. Press the PREV/ADRS MNTR keys to begin searching toward address 0000 (decrementing direction.)

Key operation	Display	Note
		Display is cleared.
1 0 0		Search starting address is set. If the starting address is 0000, it may not be entered necessarily.
1 2 3		Searching instruction is set.
		Indicate while searching (communicating with PC)
		Search is done in the address incrementing direction.
		Indicates there are no more searching instructions.

Fig. 4-14 Search Example

NOTE: The above is displayed when the given instruction has not been found after searching up to the address 0000 or the largest address.

Data Memory Search:

It is possible to know the data memory assigned address without specifying the instruction. For example, to find the address that uses the auxiliary relay 200:

1. Press CLEAR
2. Press CONV and enter the data memory kind to be searched.
3. Enter the data memory number.
4. Press SRCH
5. Press MNTR to begin searching toward ending address in an address incrementing direction. Press the PREV/ADRS and MNTR keys to begin searching toward address 0000 (decrementing direction.)

Key operation	Display	Note
		Display is cleared.
		Relay 000 is set.
		TMR, CNT numbers are set.
		Relay number is set
		Searches the given data memory.
		Search is continued.

Fig. 4-15 Data Memory Search Example

Since pressing the CONV key after CLEAR changes the data type displayed on the Programmer, set the data memory number after bringing the data memory to be searched on display.

000(relay) 00(TMR, CNT) J.00(register) 000(relay)

Program Check

1. Checking Memory

The PC checks the Parity down to the F-40 (END) instruction during each scan. The result is stored in the special relay 670. An entire program can be checked for a memory error in the PROGRAM mode.

Use this procedure to check for memory errors:

- Enter the PROGRAM mode.
- Push the CLR key.
- Push the * key twice.
- Push the CLR key again. This starts the check.

Memory check	Display
Normal	
Error	

Fig. 4-16 Program Check Indications

To indicate the address where memory error occurs, press ADRS when PE is displayed as above.

If a memory error is indicated return to normal operation and proceed as follows:

1. If you are just beginning to program, clear the entire memory area.
2. Press the MNTR key and read the contents of the address where the error exists. Enter the correct instruction.

If the memory error still exists after following these procedures check special relay 672 (battery failure). If the battery is OK, replace the memory of the controller.

2. Checking the Program

Before a trial run of the program, and after program revisions you should always check for errors. It is essential to correct any errors before the program is run.

A. Contents of the program check

1. Stack (F-30/F-31) operating status of instructions
2. MCS/MCR (F-41/F-42) operating status
3. JCS/JCR operating status
4. Double use of OUT instructions
5. Double use of TMR and CNT instructions
6. Omission of END instruction

B. Program check procedure:

1. Enter the PROGRAM mode.
2. Push the CLR key.
3. Push the * key twice.
4. Push the SRCH key to begin the search.

Key operation	Display	Note
CLR 2 2 SRCH	0000 0000 0000 0000	Normal
Error examination	0000 0000 EE 0000	Double use of the F-41(JCS) instruction.

To indicate the address where an error occurs, press ADRS.

Fig. 4-17 Error Code Displayed

Program Error Message List

Message	Address	Significance	Action
P		No syntax error found in the program.	
E 1	Address where stack overflow is met.	Use of too many STR (NOT) instructions.	Delete STR(NOT) or insert AND(OR)STR.
E 2	Address where stack underflow is met.	Short of STR(NOT) or too many use of AND (OR)STR.	Insert STR(NOT) or delete AND(OR)STR.
E 3	Address where F-40(END) is written.	Data are remaining in the stack even after F-40(END).	Insert or delete instructions.
E 4	Address where the error is found.	F-31(MCR) is used without preceding F-30(MCS).	Delete F-31(MCR) or insert F-30(MCS).
E 5	Address where F-40(END) is written.	F-30(MCS) has not been reset before F-40(END).	Insert F-31(MCR).
E 6	Address where F-41(JCS) doubled.	Another F-41(JCS) is used within an effective range of F-41(JCS). Nesting is not permitted for F-41(JCS)	Delete F-41(JCS).
E 7	Address where the error is found.	F-42(JCR) is used without preceding F-41(JCS).	Delete F-42(JCR) or insert F-41(JCS).
E 8	Address where F-40(END) is written.	F-41(JCS) has not been reset before F-40(END).	Insert F-42(JCR).
E 9	Address where the same output instruction is found.	Double use of the same relay for output instruction (OUT).	Correct the relay number of the output instruction.
E A	Address where the data memory is used double.	Double use of TMR, CNT number.	Correct the TMR, CNT number.
E b	0000	F-40(END) does not exist in the program.	Write F-40(END).

Program Correction

Program revision is inevitable because of changes to the ladder diagram, key entry errors, and errors that are found during the program check.

1. Find the address and instruction to be corrected on the display by using the read and search functions.
2. Correct the instruction or number.
3. Enter the correction.
4. Check the instruction in front of, and behind, the correction.

Note

Changing a 1 word instruction to a 2 word instruction may cause an error due to lack of memory space if the program area is full. The PE-0105 Programmer will indicate same displaying F.E and the PROG LED will remain lit.

To change an instruction:

Key operation	Display	Note
After search		
		OR NOT is revised to OR and the data section is reset, then.
  		Data memory is set.
		Revised instruction is stored.
After search		
   		TMR 12 is revised to CNT 13. The preset value is now 0000.
		
  		The preset value is set to 0015.

Fig. 4-18 Changing Instructions

To change Data Memory, a preset value, etc.

Key operation	Display	Note
After search		
		237 is corrected to 235.
After search		
		The preset value is read.
		0050 is corrected to 0010. Pay attention to the number in the data section.

Fig. 4-19 Changing Data Memory

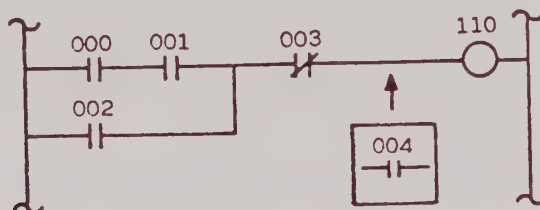
After the instruction or numeric value is changed, be sure to check the display. It should show the corrected value.

Inserting an Instruction

This procedure will insert a new instruction into program memory:

1. Bring the memory address or its contents onto the display by using the addressing, searching, or reading functions.
2. Enter a new instruction on the display.
3. Push the INS key.

Example: (Inserting an AND condition)



Address	Instruction
0100	STR 000
0101	AND 001
0102	OR 002
0103	AND NOT 003
0104	OUT 110

Address	Instruction
0100	STR 000
0101	AND 001
0102	OR 002
0103	AND NOT 003
0104	AND 004
0105	OUT 110

Key operation	Display	Note
CLEAR OUT 1 1 0 SEARCH INTR		Searches where 110 is.
AND 4		A new instruction is entered.
INS		AND 004 is inserted.
NEXT ADDR		(Confirmation is done that all instructions after the insertion were moved properly.)

Fig. 4-20 Inserting an AND

Each press of the INS key causes all instructions after this step to increment one step. Two word or three word program steps are also moved by 2 or 3 steps respectively.

Insertion will not occur if it would go beyond the programming capacity.

Insertion is not possible between the 2nd or 3rd word of a two word or three word instruction. (Preset, register, constant)

Deleting an Instruction

The following describes how to delete an instruction from the program memory:

1. Find the instruction to be deleted by using the addressing, searching, or reading functions.
2. Push the DEL key just once.

Example: (delete contact of a previous example)

Key operation	Display	Note
		Get on the display the instruction to be deleted. (As the instruction of AND 004 is deleted, all instructions after OUT 110 are moved backward.
		
		

Fig. 4-21 Deleting an Instruction

Each press of DEL will cause all of the instructions after this step to decrement (move towards 000). For two or three word instructions, program steps are also moved by 2 or 3 steps respectively.

Insertion is not possible for the 2nd or 3rd word of a two word or three word instruction. (Preset, register, constant)

Monitor Mode

In the MONITOR mode the PC can monitor program contents, relay ON/OFF states, and TMR and CNT current values. Press these keys to enter the MONITOR mode:

* * MNTR 8
 MODE SET

The MONITOR indicator on the controller panel should turn ON.

To Monitor Relays

There are three ways to read the program contents and monitor the ON/OFF state of relays:

- a. Specify the address
- b. Search for the instruction
- c. Search the data memory

1. Specifying the Address

- a. Push the CLR key.
- b. Press the ADRS key.
- c. Enter the memory address to be read.
- d. Push the MNTR key. The program contents will be displayed.
- e. To continue reading, press the NEXT ADRS key or the PREV ADRS key.

While the program is being monitored, the state of the coil and contact point is displayed by the ON indicator on the PP-0105 Programmer panel and updated on each scan. The following example assumes that latched relays 000, 001, 003, and 110 are ON.

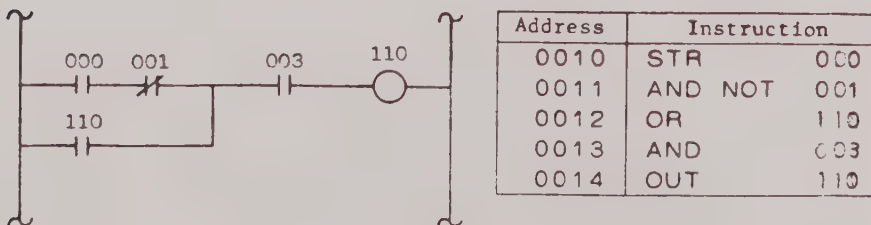


Fig. 4-22 Monitor Logic Example

Key operation	Display	Note
CLEAR ADDRS 1 0		The address is specified.
MONTR		The contents of the address 0010 are read.
NEXT ADDRS		Indicate OFF status
NEXT ADDRS		
NEXT ADDRS		
NEXT ADDRS		

Fig. 4-23 Monitor Procedure

Even though coil 001 is in the ON state, monitoring address 011 will not light the OFF indicator.

ON/OFF indication will not be shown when an instruction other than STR, AND, OR, and OUT is monitored.

Operational flags (654, 656, 657) are indicated OFF on the display regardless of the actual operating condition.

To monitor after searching for a specific instruction:

1. Push the CLR key.
2. Enter the starting search address.
3. Enter the instruction to be searched for.
4. Push the SRCH key.
5. Push the key that directs the search direction. (Press the MNTR key to search from the starting address to the last address. Press the PREV ADRS key and then the MNTR key to search from the starting address to address 000.

The example below shows the procedure using the ladder chart of the previous example.

Key operation	Display	Note
CLEAR OUT 1 1 0		The instruction is entered.
SRCH MNTR		Searching is done in the address incrementing direction from the address 0000.
PREV ADRS		Read is done from the address decrementing direction
PREV ADRS		
PREV ADRS		
PREV ADRS		

Fig. 4-24 Monitor After Searching for Specific Instruction

To Monitor after searching the Data Memory

1. Push the CLR key.
2. Push the CONV key and enter the type of data memory to be searched for.
3. Enter the data memory number.
4. Push the SRCH key.
5. Push the key that directs the search direction. Press the MNTR key to search from the starting address to the last address. Press the PREV ADRS key and then the MNTR key to search from the starting address to address 000.

Key operation	Display	Note
   		Searches the data memory 110 to be searched.
 		
 		Repeats searching the address which uses the data memory 110 .
  		Search is done in the address decrementing direction.

Fig. 4-25 Monitor Display Searching Data Memory

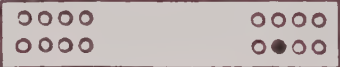
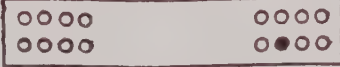
Data Memory Monitor

Relay ON/OFF state; TMR, CNT current values; and current register values can be monitored from a data memory address.

- Push the CLEAR key.
- Push the CONV key repeatedly to set the data memory area to be monitored. The display will cycle from octal (000), to decimal (00), to bytes (00).
- Enter the data memory number.
- Push the MNTR key to display the ON/OFF state or current value.

1. Monitoring Relays

The following shows the procedure to monitor data memory 000 to 717 by specifying the desired address.

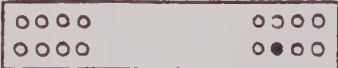
Key operation	Display	Note
		
		Relay number is entered.
		The relay 003 is OFF.
		The relay 004 is ON.
		
		
		

NOTE: When the operational flag (654,656,657) is monitored, the ON indicator on the P-0105 goes off regardless of actual state.

Fig. 4-26 Relay Monitoring

2. Monitoring TMR and CNT

The following example shows the procedure to monitor the current value of the data memory address 00 thru 57.

Key operation	Display	Note
		
		
		
		{ The current value which the CNT is used in the data memory 01 is 0003 .
		
		{ Indicates that TMR 02 has timed out, or the data memory is in use.
		CNT 03 has timed out

NOTE: If the data memory has not been used, it will be displayed in the time-up condition as shown.

Fig. 4-27 Monitoring TMR, CNT

3. Monitoring Register Values

The following procedure monitors registers in data memory addresses]00 to]71.

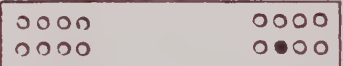
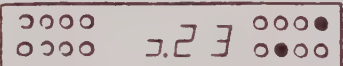
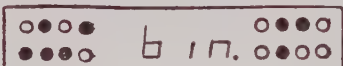
Key operation	Display	Note
		The instruction display section is cleared.
 		Data memory area is entered.
 		Data memory number is entered.
		The current value of]023 is 15 in the hexadecimal notation.
		Data memory address is monitored in the address incrementing direction.
		Changed from the hexadecimal notation to the decimal notation.
		Convert from decimal to bit pattern.
		Convert to data memory number.
		Convert to hexadecimal again.

Fig. 4-28 Monitor Register Values

Change Mode

All the functions in the MONITOR mode are available in the CHANGE mode. The CHANGE mode functions are:

- a. select latched relays,
- b. TMR and CNT set/reset,
- c. change current register values,
- d. change TMR and CNT preset values, and
- e. change the value of a constant.

To enter the CHANGE mode.

* * CHNG SET
 MODE 8

The CHANGE indicator will be ON.

Setting and Resetting Latched Relays

It is possible to set and reset latched relays 600 thru 647 directly:

1. Monitor the latched relay as described in the Monitor Mode section.
2. Push the SET/8 key to set the latched relay; or push the RESET/9 key to reset the latched relay.

Key operation	Display	Note
		The retentive relay 600 is monitored.
		The retentive relay 600 is set.
		The retentive relay 600 is reset.

Fig. 4-29 Setting/Resetting Latched Relays

Set or reset can only be executed in the operational period immediately after key entry. If the latched relay is used for an output instruction, it can be set or reset depending on the operational result.

Setting/Resetting TMR and CNT

The following describes how to reset the TMR or CNT values in the program to 0000 (time-out count-out), or to reset the preset value:

1. The TMR and CNT current values can be monitored using the procedure as described in the Monitor Mode Section.
2. Push the SET/8 key for time out or count out (reset to 0000); or push the RESET/9 key to reset to a preset value.

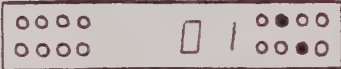
Key operation	Display	Note
  1		
		The current value of TMR 01 is monitored.
 8		Causes TMR to time out
 9		The current value of TMR 01 is preset to 1000.

Fig. 4-30 Setting TMR and CNT

It is not possible to set TMR and CNT when the TMR counter input is OFF; or when the CNT reset input is reset.

Changing Current Register Value

In the CHANGE mode it is possible to convert the current value of any register into hexadecimal, decimal, or bit pattern equivalent only if the preset value change coil (665) is ON.

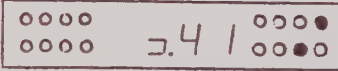
Key operation	Display	Note
   4 1		
		Data memory 241 is monitored.
4 5		The current value 23 is changed to 45.
		The revised current value is written in the memory.
		Convert to decimal. (when the three digits are indicated, they indicates decimal number.)
		Changed to the bit pattern.
1 0 1 1 0 0 		Changed to 00101100.

Fig. 4-31 Changing Current Register Value

Changing Current TMR and CNT Preset Values

The following describes how to change the preset values while the PC is running. EXTREME CAUTION IS ADVISED !!!

Key operation	Display	Note
    		TMR 01 is searched.
		The preset value 0100 is read after advancing address.
 		Depress the key several times to set the data display section to 0.
  		Enter the new preset value 0200.
		The new preset value is stored in the memory.

Fig. 4-32 Changing TMR and CNT Preset Value

The new preset value will be valid immediately after entry. If a ROM is used for program memory, change will not be permitted.

Changing Constant

The following describes how to change the value of a constant while the PC is running. EXTREME CAUTION IS ADVISED !!!

Key operation	Display.	Note
CLEAR FUN 1 SDCM MNTA		F-01 is searched.
INSTR ADDR		The BCD constant is read by advancing address.
0		The key is depressed several times to set the display section to 0.
1 5		The new BCD constant is entered.
ENTER		The new BCD constant is stored in the memory.

Fig. 4-33 Changing Constant

Confirm the instruction in front of and behind the change, before writing it into memory. If ROM is used for program memory then changing the constant is not permitted.

Recording and Verifying

Using the jack on the right side of the PP-0105 Programmer, you can record the program memory and system memory contents onto cassette tape. Connect the tape recorder MIC jack to the cassette jack of the PP-0105 Programmer using the interface cable supplied with the programmer. Verifying is highly recommended following a recording to eliminate any errors that may have occurred during the taping.

To Record:

1. Press the CLEAR key to clear the display.
2. Press the REC key.
3. Start your tape recorder.
4. Press the SET/8 key to start the operation. It is advised to record the data for 5 times.
5. Press the CLEAR key to stop recording.
6. Stop tape recorder.
7. Push the CLEAR key to set the display in it's initial state.
8. Note the program names, memory capacity, and the data recorded on the tape.

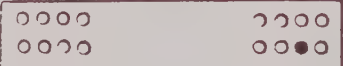
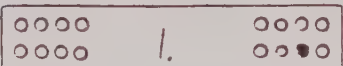
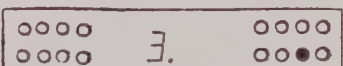
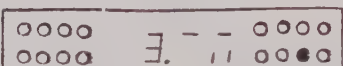
Key operation	Display	Note
		
		
		The tape recorder has started to record (flickering ADRS indicator)
		During the recording, first two (right) digits will change display continuously
		In second recording
		In third recording
		Recording is stopped in middle of the third operation.
		Display returned to its initial state.

Fig. 4-34 Display During Record

To verify the contents of the recorded tape with the contents of the PC memory, connect the tape recorder EARPHONE jack with the CASSETTE jack on the programmer using the interface cable supplied with the programmer.

To Verify:

1. Press the CLEAR key to clear the display.
2. Press the VRFY key.
3. Press the SET/8 key.
4. Start the recorder play back.
5. Push the CLEAR key to stop the verification.
6. Stop tape recorder.
7. Push the CLEAR key to bring the display into it's initial state.

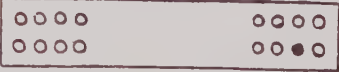
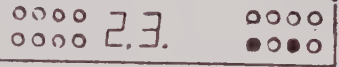
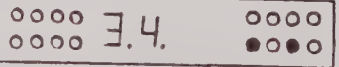
Key operation	Display	Note
		
		
		Start the tape recorder in playback mode.
		First two (right) digits change display continuously.
When receiving, the LED blinks.		Last (left) digit indicates the first verification is complete
The LED lights when verifying is completed.		When a verification error encountered, the display stops here and waits for the next verification.
		The cycle is now in the fourth verification. The 3 indicates that the third verification has been successful.
		
		Verification stops.
		The display returns to its initial state.

Fig. 4-35 Display During Verification

If no change takes place on the display or an error message occurs, increase the tape recorder's volume level. Restart verification.

Fig. 4-36 Verify Error List

Message	Significance
E 0	Start bit not found
E 1	Stop bit not found
E 2	} The program is not for 085X.
E 3	
E 4	
E 5	Unmatch verification
E 6	Check code error
E 7	Transmission error

Loading a Program from Tape

Program loading from tape is permitted only in the Program (PROG) mode. To load, insert the tape into recorder and connect the EARPHONE jack with the CASSETTE jack using the interface cable supplied with the PP-0105 Programmer. Set recorder volume to about half. Proceed as follows:

1. Press the CLEAR key to clear the display.
2. Press the LOAD key.
3. Press the SET/8 key.
4. Start the tape recorder play back.
5. Observe that "PASS" appears on display when the program has been loaded.
6. Stop the tape recorder.
7. Push the CLEAR key to return the display to it's original state.

Fig. 4-37 Loading a Program From Tape

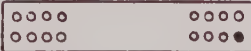
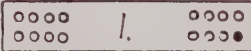
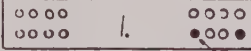
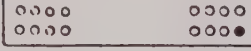
Key operation	Display	Note
		
		
		Start tape recorder to Playback mode
		First two (right) digits change
		The loading is completed.
		When receiving, the LED blinks.

Fig. 4-38 Loading Error List

Loading error list

Message	Significance
E 0	Start bit not found
E 1	Stop bit not found
E 2	} The program is not for 085X.
E 3	
E 4	
E 6	Check code error
E 7	Transmission error

E0 thru E6 may be displayed if playback volume level is insufficient.

Saving a Program

General Notes

1. The time required to transfer data from the PC to cassette tape recorder is about one minute.
2. The cassette tapes should not be stored near heat sources, in excessive humidity, or near magnetic forces.
3. Cassette tape recorder specifications:

Recording Method	: AC biased
Erase Method	: AC erased
Wow & Flutter	: .2%, max.
Output Jack	: EARPHONE jack
Input Jack	: EXT/MICrophone jack
Others	: Should have automatic level control (ALC) for recording
Tape Speed Error	: $\pm 2\%$, max.

4. Record/Playback Specifications

Transfer speed	600 bits per second
Playback input	1V RMS min
Input impedance	200 Ohms
Recording output	30mV RMS min
Output impedance	200 Ohms
Check method	CRC

5. Cautions

Use the same model of tape recorder to record and playback the tape.

The program should be recorded 5 times to eliminate recording errors.

Verify the tape after recording.

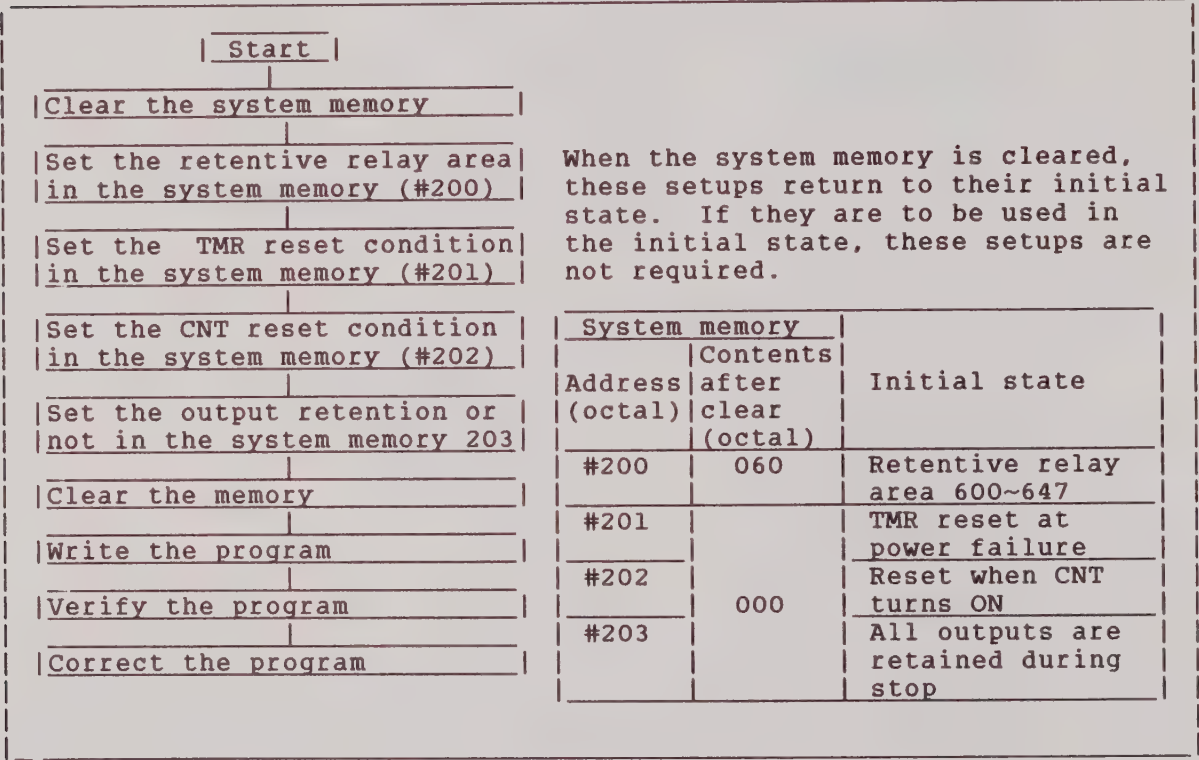
The write-protect tab on tape cassette must be broken to prevent accidental erasure.

The tape speed should be constant. If the battery power is to be used for the recorder, insure that the battery level is OK.

OPERATING THE SYSTEM

System Memory Setup and Memory Clear

After completion of ladder design phase, the program is loaded in reference to the procedure shown below using the PP-0105 or PP-0110 Programmer.



Program Memory

The Program Memory is the area in which the user program is stored. As the PC begins to operate, the program is read successively from its top address. The PC operates according to the program contents. RAM is divided into the Data Memory, Differential Memory, System Memory, and the remaining area is assigned into the Program Memory area. The contents of RAM are protected during power failures by battery.

The Program Memory of the '085 System is 928 words. There are one-word, two-word, and three-word instructions as shown below

	<u>Typical Instructions</u>	<u>Words Required</u>
One-word Inst.	STR, AND, etc.	1
Two-word Inst.	TMR, CNT, etc	2
Three-word Inst.	Application Inst.	3

System Memory

The system memory consists of 256 bytes of #000 ~ #377 and is backed up by the battery power.

- ° 128 bytes of #000 ~ #177 is used by the CPU of the control module.
- ° 128 bytes of #200 ~ 377 is open for the user which can be used for various program-mable controller function setup.

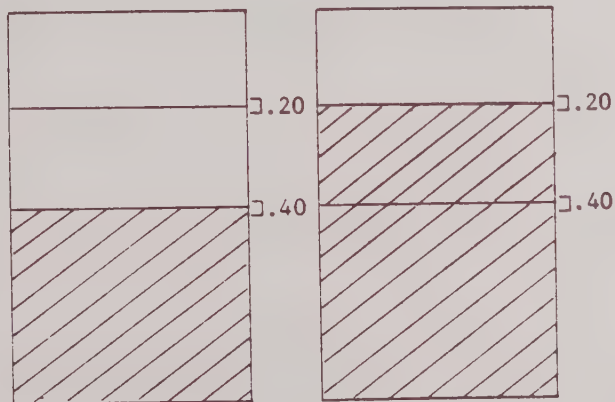
Area not open to user		Area open to user	
#000	#100	#200	#300
#001	#101	#201	#301
#002	#102	#202	#302
#003	#103	#203	#303
#004	#104	#204	#304
#005	#105	#205	#305
#006	#106	#206	#306
#007	#107	#207	#307
#010	#110	#210	#308
#074	#174	#274	#374
#075	#175	#275	#375
#076	#176	#276	#376
#077	#177	#277	#377

Area in which various control unit functions are set as shown below:

Address	Item	Description															
#200	Retentive relay area	Used to increase or decrease the retentive area size from the size given initially. The entry must be done using the data memory byte address in the octal mode. It had been set to 060 initially (the retentive relay address is 600).															
		<table> <tr> <th>Relay</th><th>Relay address</th><th>Relay address</th></tr> <tr> <td>Input relay</td><td>000~107</td><td>] .00~] .10</td></tr> <tr> <td>Output relay</td><td>110~167</td><td>] .11~] .16</td></tr> <tr> <td>Auxiliary relay</td><td>170~577</td><td>] .17~] .57</td></tr> <tr> <td>Retentive relay, except special relay</td><td>600~647</td><td>] .60~] .64</td></tr> </table>	Relay	Relay address	Relay address	Input relay	000~107	] .00~] .10	Output relay	110~167	] .11~] .16	Auxiliary relay	170~577	] .17~] .57	Retentive relay, except special relay	600~647	] .60~] .64
Relay	Relay address	Relay address															
Input relay	000~107	] .00~] .10															
Output relay	110~167	] .11~] .16															
Auxiliary relay	170~577	] .17~] .57															
Retentive relay, except special relay	600~647	] .60~] .64															
		Can be entered in an increment of eight points (one byte)															
#201	TMR reset condition designation	Reset following a power failure for the TMR is set using an octal number.															
		000 ... Reset at power failure 001 ... Previous state retained at power fail.															
		It has been factory set to 000 initially.															
#202	CNT reset condition designation	Reset condition is set for the CNT instruction, or F-60(F/B SFR) using an octal number.															
		000 ... Reset with ON 001 ... Reset with OFF															
		It has been factory set to 000 initially. After the #202 counter reset condition has been changed, it affects the reset condition in the F-60 instruction, in addition to the CNT instruction.															

Address	Item	Description
#203	Output retention	This memory determines whether output modules retain their output or not at Halt of the control module.
	000 ...	All outputs modules retain their output
	001 ...	All outputs modules become OFF
		When output retention is cancelled by entering 001 into System Address #203, latch of the output module is reset and the outputs therefore go OFF when the PC is changed to the Program Mode or when the PC comes to a halt as a result of self diagnostics.

After the retentive area size has been changed, the area retained upon recovery from power failure (retentive area) is within a range of the hatched area.



#200 set to 040 #200 set to 020

ROM OPERATION

It is possible to store the program in ROM for the '085 System. When a program is stored in ROM, System Memory area #200 ~ #377 must also be written into the ROM together with the Program Memory. When the finished ROM is installed into the PC-0085 Controller the following processing results.

1. At power on, the System Memory area #200 ~ #377 is transferred from the ROM to the RAM. Thereafter the CPU operates by referring to the System Memory area in the RAM.
2. The Program Memory executes operation according to the contents of the ROM.

NOTE: Although it is possible to set the machine in the Program Mode during ROM operation and to change the contents of the System Memory 220 ~ 377, the change will become invaildated once the power is removed because the unmodified contents of those locations are again transferred from ROM to RAM.

DATA MEMORY ORGANIZATION

The table below illustrates the data memory organization:

Kind	Capacity	Relay number (bit address)	Byte Address	State after power failure
Input relay	72 points (9 bytes)	000 ~ 107	] .00~] .10	Cleared
Output relay	48 points (6 bytes)	110 ~ 167	] .11~] .16	Cleared
Auxiliary relay	264 points (33 bytes)	170 ~ 577	] .17~] .57	Cleared
Retentative relay	80 points (10 bytes)	600 ~ 717	] .60~] .71	Retained
TMR, CNT	48 total any combination (current value 96 bytes)			TMR cleared CNT retained

The data memory address is an octal number for bit addresses and byte address. Therefore, the address following 007 is address 010 and not 008.

Retentative relay is the data memory relay area which retains the state immediately before power failure, when the power is returned to system following a power failure. It is possible to increase or decrease the retentive relay area by specifying the retentative relay area in the system memory #200. The system was factory set with area 600 ~ 717 as the retentive area.

TMR retains its contents when the system memory #201 is assigned.

Data Memory Address Map

RELAY NUMBER									BYTE
INPUT RELAY AREA	007	006	005	004	003	002	001	000	] .00
	017	016	015	014	013	012	011	010	] .01
	027	026	025	024	023	022	021	020	] .02
	037	036	035	034	033	032	031	030	] .03
	047	046	045	044	043	042	041	040	] .04
	057	056	055	054	053	052	051	050	] .05
	067	066	065	064	063	062	061	060	] .06
	077	076	075	074	073	072	071	070	] .07
	107	106	105	104	103	102	101	100	] .10
	OUTPUT RELAY AREA	117	116	115	114	113	112	111	110
127		126	125	124	123	122	121	120	] .12
137		136	135	134	133	132	131	130	] .13
147		146	145	144	143	142	141	140	] .14
157		156	155	154	153	152	151	150	] .15
167		166	165	164	163	162	161	160	] .16
AUXIL. RELAY AREA	177	176	175	174	173	172	171	170	] .17
	207	206	205	204	203	202	201	200	] .20
	217	216	215	214	213	212	211	210	] .21
	227	226	226	224	223	222	221	220	] .22
	237	236	235	234	233	232	231	230	] .23
	247	246	245	244	243	242	241	240	] .24
	257	256	255	254	253	252	251	250	] .25
	267	266	265	264	263	262	261	260	] .26
	277	276	275	274	273	272	271	270	] .27
	307	306	305	304	303	302	301	300	] .30
	317	316	315	314	313	312	311	310	] .31
	327	326	325	324	323	322	321	320	] .32
	337	336	335	334	333	332	331	330	] .33
	347	346	345	344	343	342	341	340	] .34
	357	356	355	354	353	352	351	350	] .35
	367	366	365	364	363	363	363	360	] .36
	377	376	375	374	373	372	371	370	] .37
	407	406	405	404	403	402	401	400	] .40
	417	416	415	414	413	412	411	410	] .41
	427	426	425	424	423	422	421	420	] .42
	437	436	435	434	433	432	431	430	] .43
	447	446	445	444	443	442	441	440	] .44
	457	456	455	454	453	452	451	450	] .45
	467	466	465	464	463	462	461	460	] .46
	477	476	475	474	473	472	471	470	] .47
	507	506	505	504	503	502	501	500	] .50
	517	516	515	514	513	512	511	510	] .51
	527	526	525	524	523	522	521	520	] .52
	537	536	535	534	533	532	531	530	] .53
	547	546	545	544	543	542	541	540	] .54
	557	556	555	554	553	552	551	550	] .55
	567	566	565	564	563	562	561	560	] .56
577	576	575	574	573	572	571	570	] .57	

Data Memory Address Map (cont.)

	<u>RELAY NUMBER</u>								<u>BYTE</u>
	607	606	605	604	603	602	601	600	] .60
RETENT.	617	616	615	614	613	612	611	610	] .61
RELAY	627	626	625	624	623	622	621	620	] .62
AREA	637	636	635	634	633	632	631	630	] .63
	647	646	645	644	643	642	641	640	] .64
RETENT.	657	656	655	654	653	652	651	650	] .65
SPECIAL	667	666	665	664	663	662	661	660	] .66
AREA	677	676	675	674	673	672	671	670	] .67
HI-SPEED	707	706	705	704	703	702	701	700	] .70
COUNTER	717	716	715	714	713	712	711	710	] .71
CURRENT									
VALUE AREA									

Data Memory Functions - The following table summarizes the data memory.

INPUT OUTPUT RELAY

Area interfaced to input module	• ON/OFF state of the input module is read into this area during input/output processing of a scan period and will be retained for a period of one scan time. • Used for input information (contact, data) by the program.
Area interfaced to output module	• Operational result is stored into this area by the user program in terms of coil/destination. • ON/OFF state is transferred to the output unit in the input/output processing. • Operational result can be used for contact and source in the program.
Module non-interfaced area	• Operational result is written into this area by the user program. • Can be used for auxiliary relay.

AUXILIARY RELAY

- Operational result is stored into this area by the user program in terms of coil/destination.
- Used for a temporary storage of operational results which are not needed to be output to an external source.
- Operational result can be used for contact and source in the program.

RETENTIVE RELAY

- Operational result is stored into this area by the user program in terms of coil/destination.
- Used for a temporary storage of operational results which are not needed to be output to an external source.

Retentive Relay (cont.)

- Operational result can be used for contact and source in the program.
- Used for storing of contact and data of which contents should be retained during a power failure.

Dedicated area
(650 ~ 677)

- Used for flag area. It cannot be used for coil/destination in the program except for 661, 662, 663, and 665 but can be used for contact and source.

High speed counter
current value area

- Used for high speed counter current value area. If 662 is ON, current value of high speed counter will be stored in this area automatically by CPU. (085B-E)

TMR/CNT AREA

When used for TMR

- When the current value becomes "0", the TMR contact ON.
- TMR contact can be used as many times as required in the program.

When used for CNT

- When the current value becomes "0", the CNT contact ON.
 - CNT contact can be used as many times as required in the program.
-

NOTE-1: The area interfaced with the input module can retain the ON/OFF state sensed during I/O processing until the I/O processing of the next cycle. But if the area is used for coil/destination by the program, the data memory may be revised depending on the operational result in that scan cycle.

Dedicated (Special) Relay Area

The PC-0085 Controller has a 24 point retentive dedicated relay area (650 ~ 677). These relay areas are written to by the CPU and must not be used for coil and destination by the user program. However, all points except 661, 662, 663, and 665 can be used for contact and source by the user program. The Table below lists the dedicated relay areas and describes each.

Dedicated (Special) Relay Areas

Relay	Description
650 651 652 653	Used for internal operation of the programmable controller, not used by program.
654 655 656 657	Non-carry flag Carry flag Zero flag
660 661 662 663 664 665 666 667	0.1-second clock All output forced OFF High speed counter enable High speed counter reset Preset value change switch Ever off contact
670 671 672 673 674 675 676 677	Memory error CPU failure Battery value change switch I/O failure Option failure Power supply failure
700~717	Current value of high speed counter

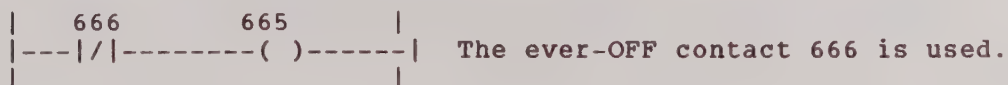
Explanation:

1. Area 654 ~ 657 (flags). These are flag areas that are set according to the operation when executing application instructions F-12 compare registers, and F-60 shift register bidirectional.

Non-carry	Carry	Zero
654	656	657

The flags are set according to the operational result of the instruction, or when the operational condition for that instruction has been met. The flag is cleared when the operational condition is not satisfactory for that instruction. The flags are not changed when executing other instructions that do not use these relay areas.

2. Area 660 (0.1 sec. clock). Used for CNT instruction clock and other application instructions.
3. Area 661 (All outputs forced OFF). When this relay is energized by program, all output are forced OFF.
4. Area 663 - High speed counter enable (models with suffix B-E only)
 - ° When 662 is set ON, high speed counter becomes available.
5. Area 663 - High speed counter reset (models with suffix B-E only)
 - ° When 663 is set ON, current value of high speed counter (].70,].71) is reset.
6. Area 665 (preset value change switch)
 - ° It is possible in the preset change mode to set and reset retentive relay (600 ~ 647). But 665 should be set ON in the program to set or reset relays (000 ~ 577) other than retentive relay or to write data from programmer into a specific register (].00 ~].64).
 - ° Logic to latch relay 665 ON at all times



- ° Logic to set relay 665 ON by the external switch



7. Area 666 (ever-OFF contact)

- ° Used to program an ever-OFF (type-a) and ever-ON contact (type-b).

8. Area 670 ~ 677 (self-diagnostic result)

- ° If an error is detected after the self-diagnosis, the relevant contact will be set ON.
- ° For details, refer to "Self-diagnosis".

9. 700 ~ 717 - Current value of high speed counter (Models suffix B-E only)

- ° This area stores high speed counter's current value as follows.

717 ~ 713	713 ~ 710	707 ~ 704	703 ~ 700
4th Digit (BCD)	3rd Digit (BCD)	2nd Digit (BCD)	1st Digit (BCD)

Relay Area Byte Address and Absolute Address

The PC 0085 controller not only carries out bit term operations like AND and OR, it also performs data transfers. A data processing instruction is handled in bytes. In order to permit data processing the I/O relay, auxiliary relay, and retentive relay areas, a byte address is required specifying the area. The PC 0085 accesses the byte address that corresponds to the relay number. The least significant digit of the three digit relay number is discarded and the symbol]. is prefixed to the three remaining digits. Example:

137	136	135	134	133	132	131	130
-----	-----	-----	-----	-----	-----	-----	-----

The byte address is].13 in the above example. It is used to specify the relay area in terms of bytes for source and destination by the application instructions.

BASIC RELAY INSTRUCTIONS

1. Store (STR)/Out (OUT) Instructions

If each logic line starts with a N.O. contact, use the STR instruction.

Ex.1

000	110	Address	Instruction	Data
----- ------()----		000	STR	0
		001	OUT	110

Keystrokes:

- | | |
|---------------------------|-------------------------------|
| 1. *, *, PROG MODE, SET/8 | Puts the 085 in the Prog mode |
| 2. CLEAR | Brings up address 0000 |
| 3. STR, 0, 0, 0, ENTER | Programs N.O. contact at #000 |
| 4. NEXT ADRS | Steps to address 001 |
| 5. OUT, 1, 1, 0, ENTER | Programs coil # 110 |

Ex.2

001	110	Address	Instruction	Data
----- ------()----		002	STR	001
002	111	003	OUT	110
----- ------()----		004	STR	002
		005	OUT	111

Keystrokes:

- | | |
|----------------------------------|-----------------------------|
| 1. NEXT ADRS | Steps to address # 002 |
| 2. STR, 0, 0, 1, ENTER, NEXT ADR | Programs N.O. contact # 001 |
| 3. OUT, 1, 1, 0, ENTER, NEXT ADR | Programs coil # 110 |
| 4. STR, 0, 0, 2, ENTER, NEXT ADR | Programs N.O. contact # 002 |
| 5. OUT, 1, 1, 1, ENTER, NEXT ADR | Programs coil # 111 |

Ex.3

003	123	Address	Instruction	Data
----- ----- --()----		006	STR	003
	124	007	OUT	123
	--()----	008	OUT	124
	125	009	OUT	125
	--()----			

Example 3 works because the OUT instruction does not effect the previous instructions.

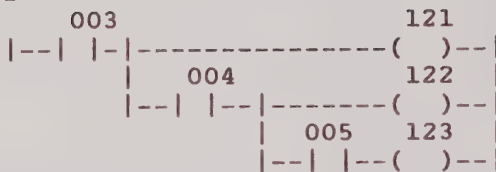
2. AND (AND) Instruction

N.O. contacts in series are processed by the AND instruction.

Ex.1

000	001	110	Address	Instruction	Data
--	----	----- ()----	000	STR	000
			001	AND	001
			002	OUT	110

Ex.2



Address	Instruction	Data
000	STR	003
001	OUT	121
002	AND	004
003	OUT	122
004	AND	005
005	OUT	123

3. OR (OR) Instruction

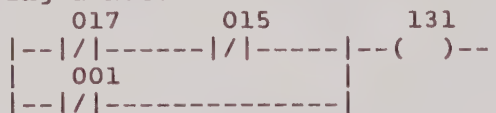
N.O. contacts in parallel are processed by the OR instruction.



Address	Instruction	Data
150	STR	023
151	OR	057
152	OUT	137

4. STORE NOT (STR NOT)/ OR NOT (OR NOT)/ AND NOT (AND NOT)

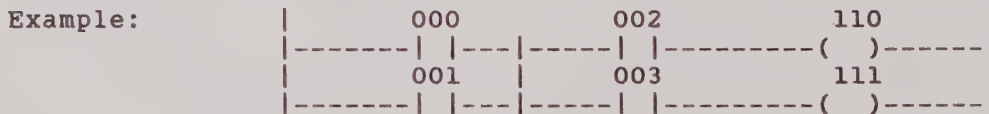
If a line starts with a N.C. contact, or a parallel/series circuit using a N.C. contact use the NOT instructions.



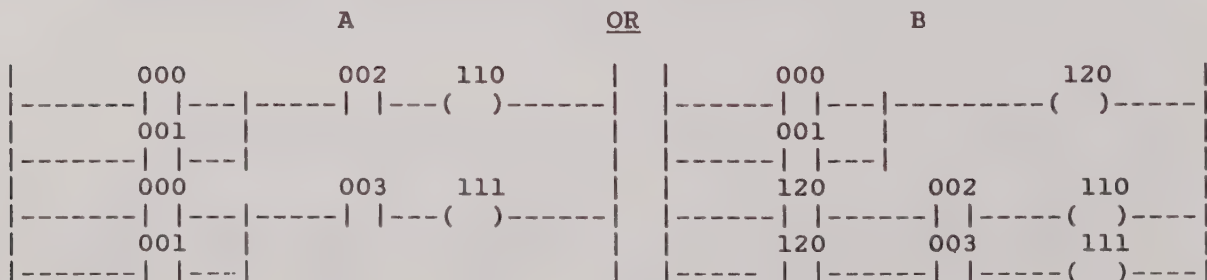
Address	Instruction	Data
000	STR NOT	017
001	AND NOT	015
002	OR NOT	001
003	OUT	131

5. Ladder Logic Diagram Cautions

The PC 0085 solves logic sequentially, therefore some ladder logic diagrams and statement logic diagrams are not equivalent.



This must be redrawn for the PC-0085:



6. Programming Series/Parallel Circuits

During the processing of serial/parallel circuits or application instructions that have multiple numbers of inputs, the intermediate results are stored in a stack register. Prior to programming the serial/parallel circuit, it should be divided into blocks. By using the STR function, you create these minor blocks and shift them into the accumulator and stack register. Executing the (AND STR)/(OR STR) functions pulls the minor blocks out of the stack, linking the minor blocks into a completed ladder program.

Block A				Address	Instr	Data
	000	001	110		000	STR 000
	---	---	---		001	AND 001 Block A
	002	003			002	STR 002
	---	---	---		003	AND 003 Block B
					004	OR STR
					005	OUT 110
Block B						

NOTE: The contents of block A are programmed in the accumulator.

```

|      000      001
|-----|-----|-----
|

```

ACC

Next the contents of block B are stored in the accumulator, pushing block A into the stack.

```

|      002      003
|-----|-----|
|

```

ACC

```

|      000      001
|-----|-----|-----
|

```

STACK

The (OR STR) function pulls block A out of the stack and block B is ORed with it.

```

|      000      001
|---|---|-----|---|
|      002      003
|---|---|-----|---|
|

```

ACC

ie;

```

|      000      001
|-----|-----|-----
|      002      003
|-----|-----|-----
|

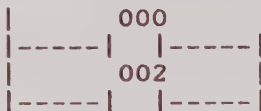
```

ACC

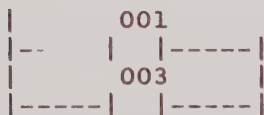
EX. 2

Block A		Block B			Address	Instruction	I/O
000	001	110			000	STR	000
				()	001	OR	002 Block A
					002	STR	001
002	003				003	OR	003 Block B
					004	AND STR	
					005	OUT	110

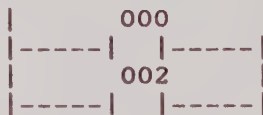
NOTE: The contents of Block A are stored in the accumulator.



Next the contents of Block B are stored in the accumulator and Block A is pushed into the stack.



ACC



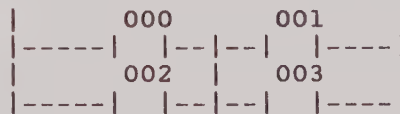
STACK

The (AND STR) pulls Block A out of the stack and attaches it in front of Block B, connecting the top rung.



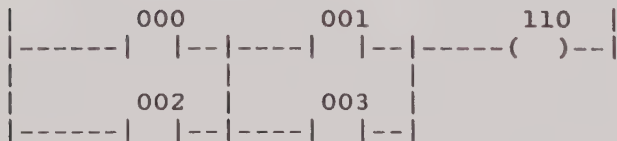
ACC

ie;



ACC

The (out) function programs the coil.



ACC

EX. 3

Block A	Block B	Block C		<u>Address</u>	<u>Instruction</u>	<u>I/O</u>
000	001	002	110	000	STR	000
---	---	---	()--	001	OR	003
				002	STR	001
003	004	005		003	OR	004
---	---	---		004	STR	002
				005	OR	005
				006	AND STR	
				007	AND STR	
				008	OUT	110

EX 4

				<u>Address</u>	<u>Instruction</u>	<u>I/O</u>
000	001	002	110	000	STR	000
---	---	---	()--	001	STR	001
				002	AND	002
	003			003	OR	003
	---	---		004	AND STR	
004				005	STR	004
---	---	---		006	OR STR	
				007	OUT	110

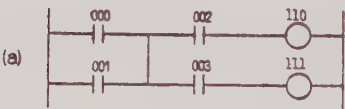
LADDER DESIGN NOTES

Since the programmable controller operates in the serial mode in which program contents are read successively and executed, some restrictions to conventional Relay Board ladder charting techniques are applicable. Also, one-way control diodes used on conventional relay boards may not be necessary.

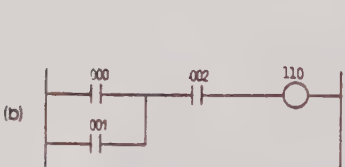
Differences in ladder design between conventional relay boards and the programmable controller should be comprehensively understood in order to comprise more effective ladder chart.

Examples of Relay Circuits That Need Revision:

Example 1



The programmable controller can not execute the ladder chart (a) without revision.

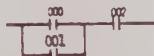


Part (b) can be executed with the program revised as shown.

Instruction	
STR	000
OR	001
AND	002
OUT	110

Fig. 4-39 Examples of Relay Circuits Needing Revision

The state of the accumulator makes transition in the following manner when the program (b) is executed.

Instruction	Accumulator content
STR 000	
OR 001	Result of 
AND 002	Result of 
OUT 110	Result of 

As each step of the program is executed, the accumulator content is changed and represented by 0 or 1. Thus, execution of AND 002 updates the result of OR 001 so that the accumulator would not be able to "consider" 003. Consequently the chart has to be revised in the following way for the programmable controller ladder chart.

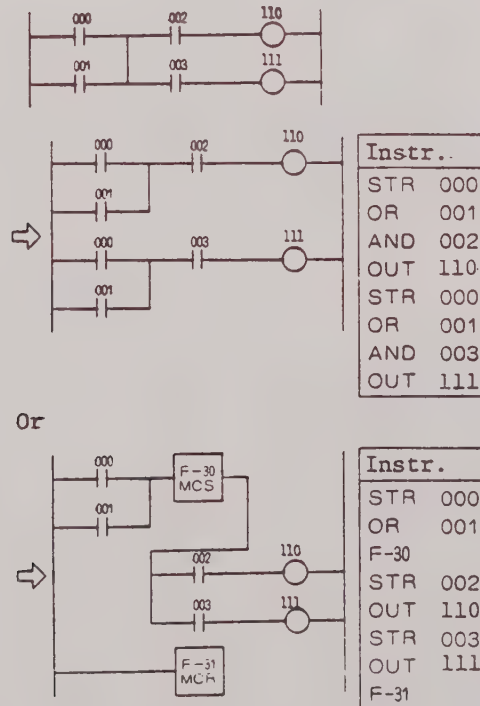


Fig. 4-40 Revised Program Example

Or

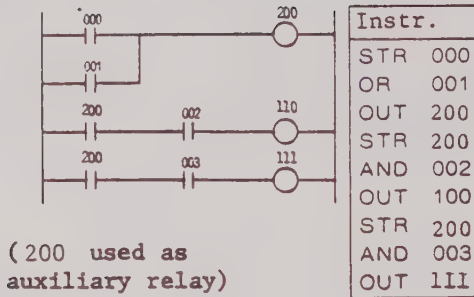
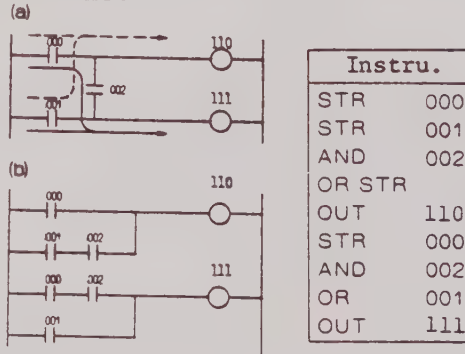


Fig. 4-40 Revised Program Example (cont.)

Refer to Description of Application Instructions for details of the F-30 (MCS) and F-31 (MCR) instructions.

Example 2

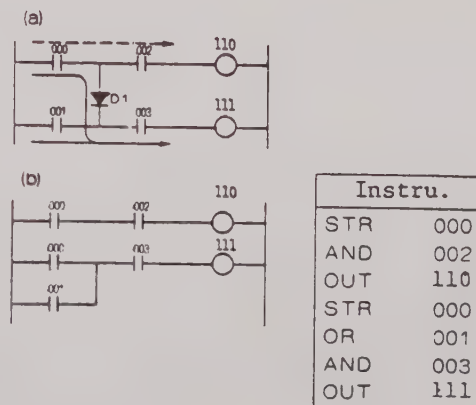
With the relay board ladder chart of (a), current flows to 002 from both 000 and 001. This must be revised for execution with the programmable controller as shown in program (b).



Because execution takes place serially from the address 0 to the END instruction with the programmable controller, it is not possible to go through the same contact symbol on the ladder chart twice.

Example 3

Because of the one-way control diode D1 in the relay board circuit of (a), the current does not flow from 001 to 002. This relay board chart must be re-written as shown in program (b) for the programmable controller.



Simplifying Programs:

Programs may be simplified when the circuit is revised depending on the sequence circuit.

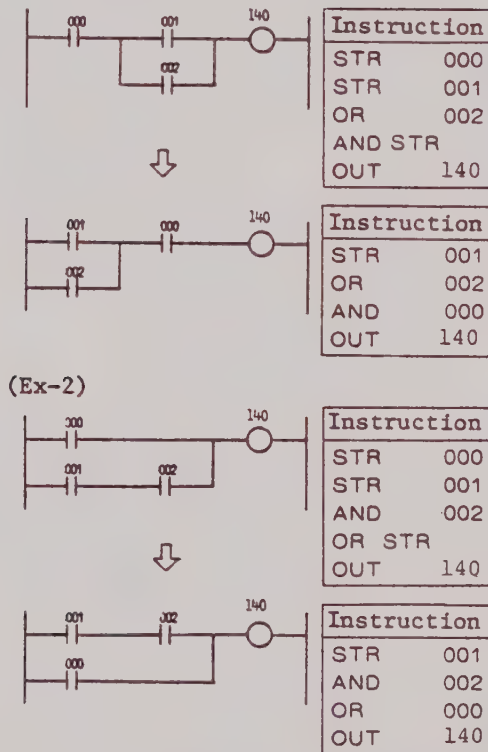


Fig. 4-41 Simplifying Programs

Generally, the program may be simplified when programmed with more weight on the left side.

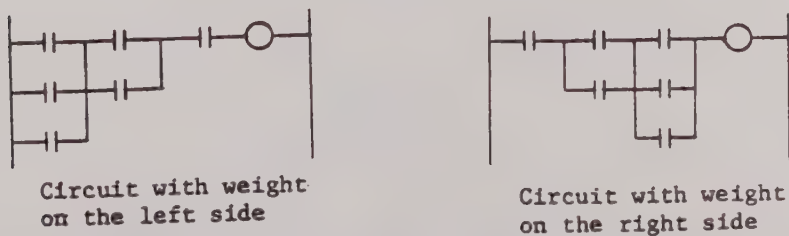
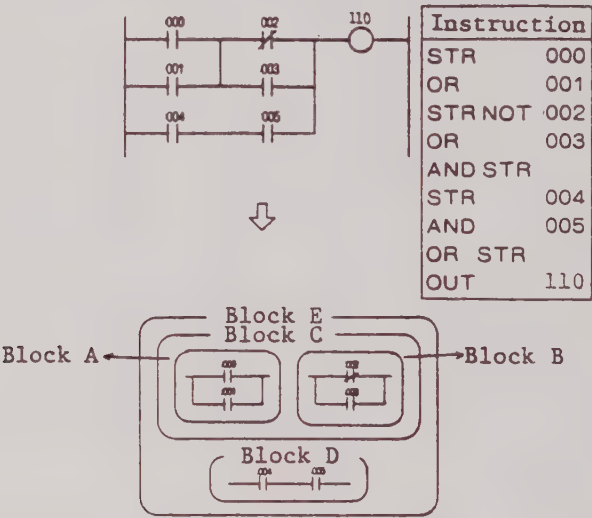


Fig. 4-42 Left/Right Side Weighting

Programming Serial/Parallel Circuits:

Prior to programming serial/parallel circuits, they should be divided and programmed in minor blocks, then assembled into a major program as shown in the example below and on the following page.

Example 1



	Instruction	Accumulator ACC	Stack register S ₁
A	STR 000		State of the ACC immediately before
	OR 001		
B	STR NOT 002		
	OR 003		
C	AND STR		
D	STR 004		
	AND 005		
E	OR STR		
	OUT 110		

Fig. 4-43 Programming Serial/Parallel Circuits Example

Fig. 4-43 Programming Serial/Parallel Circuits Example (cont.)

Example 2

Instru.	Accumulator ACC	Stack register		
		S1	S2	S3
STR 000		(*)		
AND 001				
STR 002				
AND 003				
STR 004				
AND 005				
OR STR				
AND 006				
OR STR				
STR 007				
AND 010				
STR 011				
STR 012				
OR 013				
AND STR				
OR STR				
AND STR				
OUT 120				

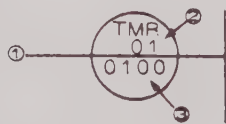
(*): State of the accumulator immediately before

Using the TMR (timer instruction)

The instruction decrements the timer at 0.1 second intervals. Timing does not take place while the start input is OFF. When the timer's start input is ON, the current timer value is decremented by 1 every 0.1 seconds. When the current value reaches 0, the TMR contact turns ON; and remains ON as long as the start input is ON.

START INPUT	CURRENT VALUE	TMR CONTACT
OFF	Preset value	OFF
ON (current value > 0)	Decrement by one every 0.1 second	OFF
ON (current value = 0)	0	ON
ON → OFF (current value > 0)	Reset to the preset value	OFF
ON → OFF (current value = 0)	Reset to the preset value	ON → OFF

Symbol representing the TMR instruction



Symbol representing the TMR contact



- 1. Start input (start with ON state of signal)
- 2. TMR number 00 ~ 57 ... Used common for CNT
- 3. Preset value 0001 ~ 1999 (BCD) ... In an increment of 0.1 second (000.1 ~ 199.9 seconds)

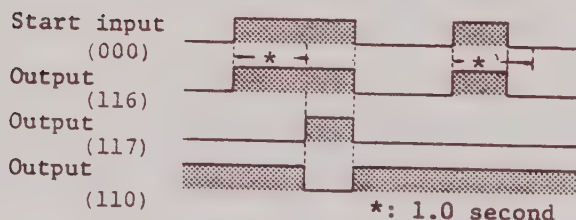
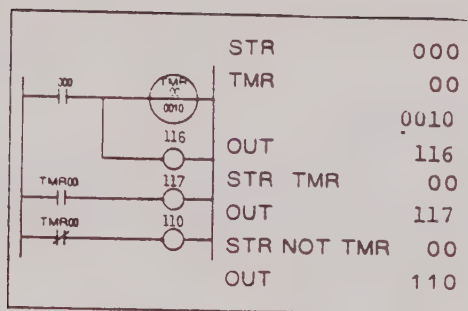


Fig. 4-44 Sample TMR Program & Timing Chart

Because the TMR and CNT instructions use the same memory area, a number can only be used once in a program.

The TMR contact can be the same number as the TMR number; and any number of a-type (N.O.) contacts or b-type contacts (N.C.) can be used.

The timer is reset on power up. The preset value will be used for the current value when the power is turned on (if the Reset input is ON).

By setting the timer's reset condition in the system memory (#201), it is possible to store the state at the time of power interrupt.

It is possible to implement the power failure timer and timers differing in their start and reset conditions by making use of the contact 660 (0.1 second clock) and the CNT instruction.

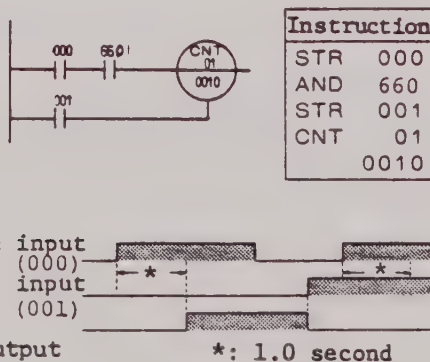


Fig. 4-45 Using a Clock and CNT & Timing Chart

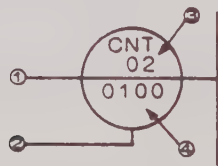
Using the CNT (counter instruction)

The CNT instruction decrements the counter by one on every low to high transition of the counter input.

No counting takes place if the reset input is ON. As the counter input changes from OFF to ON while the reset input is OFF, the current CNT value decrements by one. When the current value is 0, the CNT contact is turned ON; and remains ON as long as the reset input is OFF.

Reset input	Current value	CNT contact
ON	Preset value	OFF
OFF (current value > 0)	Decrement by one every time the Counter input change from OFF to ON	OFF
OFF (current value = 0)	0	ON
OFF → ON (current value > 0)	Reset to the preset value	OFF
OFF → ON (current value = 0)	Reset to the preset value	ON → OFF

Symbol representing
the CNT instruction



Symbol representing
the CNT contact



- 1. Counter input (senses OFF to ON Transition)
- 2. Reset input (reset with ON)
- 3. CNT number 00 ~ 57 (octal number) ...
Used commonly with TMR.
- 4. Preset value 0001 ~ 1999 (BCD)

Because the TMR and CNT instructions use the same memory area, it's number can only be used once in a program.

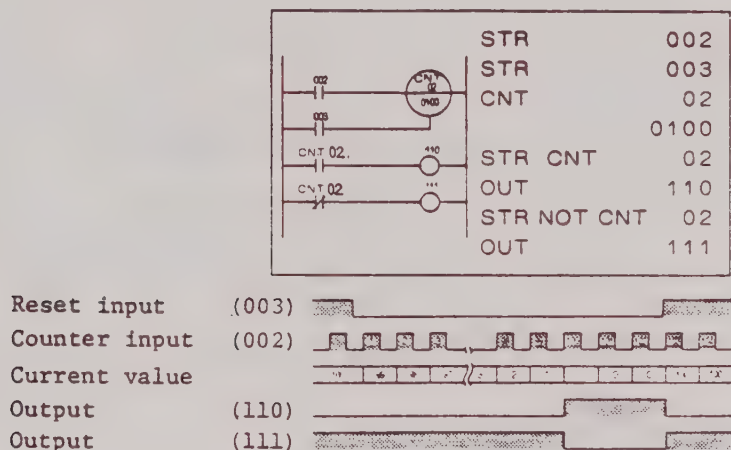


Fig. 4-46 Sample CNT Program & Timing Chart

The CNT contact can be the same number as the CNT number; and any number of a-type (N.O.) contacts or b-type contacts (N.C.) can be used.

When the counter reaches zero the reset input must be turned on to start counting again.

When both the counter input and reset input go ON simultaneously, the reset input takes precedence.

If the power is interrupted, the counter retains its current value. The current value will be reset if the reset input is turned ON at power on. Setting the reset condition in the system memory (#202) will give control over the state of the reset signal at power up.

SECTION 2 DESCRIPTION OF APPLICATION INSTRUCTIONS

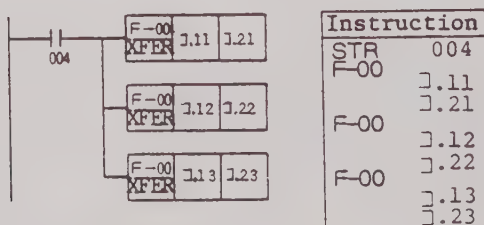
The '085 System offers the user 12 higher-level special instructions that are application oriented as described in the following section. Following the description, refer to the few notes in regard to these application instructions.

F-00	Transfer one byte of data
XFER	

Symbol	F-00 XFER S D	[Explanation]				
Function	The contents of register S (one byte data) are transferred to register D.	004 F-00 XFER].12].14 <table><tr><th>Instr.</th></tr><tr><td>STR 004</td></tr><tr><td>F-00].12</td></tr><tr><td>].14</td></tr></table>	Instr.	STR 004	F-00].12	].14
Instr.						
STR 004						
F-00].12						
].14						
Operation	S→D	When the input condition 004 changes from OFF to ON, the contents of register].12 are transferred to].14.				
Range of S applicable	].00~].71 (NOTE-1)					
Range of D applicable	].00~].71 (NOTE-1)					
Operational condition	At a rising edge of signal (OFF to ON)	].12 01110101 →].14 01110101				
A Contents of S	Unchanged					
F O						
T P Contents of D	Contents of the register S					
E S						
R Flag	Unchanged					

NOTE-1:].65 ~].71 is the special area.

REFERENCE: To transfer more than two bytes in succession, either repeat the F-00 instruction as shown below.



F-01	Transfer BCD constant
BCD	

Symbol		[Explanation]								
Function	A 2-digit BCD constant "n" is transferred to register D.	<table><tr><th colspan="2">Instr.</th></tr><tr><td>STR</td><td>004</td></tr><tr><td>F-01</td><td>15</td></tr><tr><td></td><td>J.20</td></tr></table>	Instr.		STR	004	F-01	15		J.20
Instr.										
STR	004									
F-01	15									
	J.20									
Operation	N→D	When the input condition 004 changes from OFF to ON, the BCD								
Range of "n" applicable	00~99	constant "15" is transferred to register J.20.								
Range of D applicable	J.00~J.71 (NOTE-1)	The following value is contained in register J.20 after the transfer.								
Operational condition	At a rising edge of signal (OFF to ON)									
A Contents	n(00~99)									
F O of D										
T P Flag	Unchanged									
E										
R										

J.20

NOTE-1: J.65 ~ J.71 is the special area.

F-07	Transfer decimal constant
DCML	

Symbol			[Explanation]								
Function	The decimal constant "n" is transferred to the register D.		 <table border="1" data-bbox="1013 217 1188 331"> <tr><th colspan="2">Instr.</th></tr> <tr><td>STR</td><td>004</td></tr> <tr><td>F-07</td><td>015</td></tr> <tr><td></td><td>J.20</td></tr> </table>	Instr.		STR	004	F-07	015		J.20
Instr.											
STR	004										
F-07	015										
	J.20										
Operation	n→D										
Range of "n" applicable	000 ~ 255										
Range of "D" applicable	J.00~J.71 (NOTE-1)		- When the input condition 004 changes from OFF to ON, the decimal constant 15 is transferred to register J.20. - Register J.20 has the following binary code representation.								
Operational condition	At a rising edge of signal (OFF to ON)										
A	Contents	n(000~255)									
F O	of D										
T P	Flag	Unchanged									
E											
R											

NOTE-1: J.65 ~ J.71 is the special area.

F-12	Comparison Between Registers
CMP	(CoMPare)

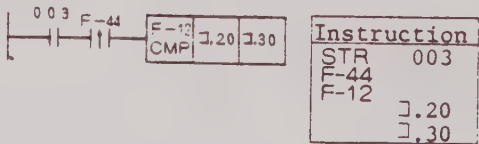
Symbol	F-12 CMP S₁ S₂		[Explanation]
Function	The contents of register S ₁ are compared with the contents of register S ₂ .		003 F-12 CMP J.20 J.30 Instr. STR 003 F-12 J.20 J.30 When the input condition 003 is ON, the contents of register J.20 are compared with the contents of register J.30. Its results are set in the non-carry flag (654), carry flag (656), and zero flag (657). Registers J.20 and J.30 remain unchanged after this operation.
Operation	S ₁ <=> S ₂		
Range of S ₁ applicable	J.00~J.71 (NOTE-1)		
Range of S ₂ applicable	J.00~J.71 (NOTE-1)		
Operational condition	When the input signal is in the ON state (not limited to the OFF to ON transition).		° Transition of register contents
A F T E R O P E R A T I O N	Contents of S ₁	Unchanged	
	Contents of S ₂	Unchanged	
	Flag	Result	a b c
		S ₁ > S ₂	1 0 0
		S ₁ = S ₂	1 0 1
		S ₁ < S ₂	0 1 0
		a:Non-carry	654
		c:Carry	656
		d:Zero	657
			As long as the condition is ON, comparison is done every scan, and the zero flag is Turned ON. (*a):Non-carry flag (*b):Carry flag (*c):Zero flag

NOTE-1: J.65 ~ J.71 is the retentive relay special area.

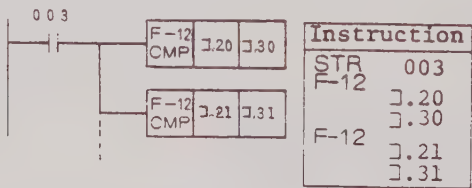
NOTE-2: As long as the input signal is ON, comparison is done every scan cycle.

NOTE-3: State of the flag will be kept valid until the instruction that affects a next flag in that scan cycle is met.

REFERENCE: To make a comparison only when the input condition changes from OFF to ON, use the differentiate instruction in conjunction with the input condition.



REFERENCE: To compare data of more than two bytes, it should be programmed such that the comparison takes place from a lower order digit. If the F-12 were programmed repeatedly, the contents of the carry flag (656) are also compared after the second F-12 instruction. (For the F-12 instruction that follows the STR instruction, the contents of the carry flag (656) are removed from the comparison.)

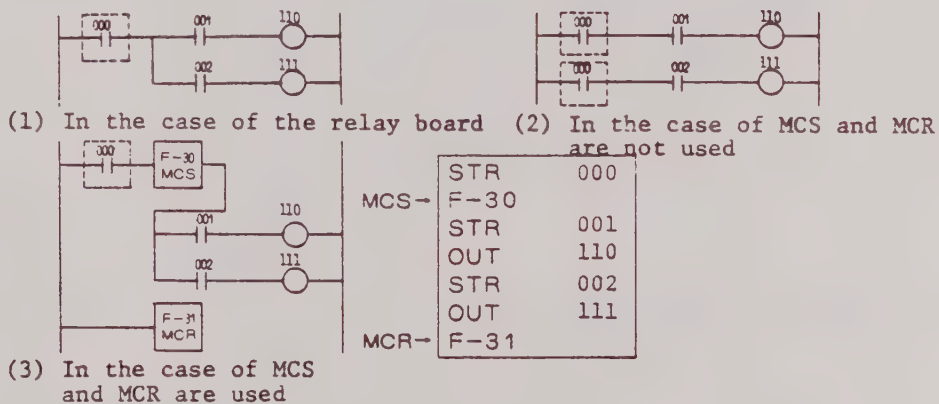


When programmed from a low order digit, the carry-down information is forwarded to a higher digit.

F-30	Set master control
MCS	(Master Control Set)

F-31	Reset master control
MCR	(Master Control Reset)

MCS and MCR should be used when the circuit after the common operational condition is branched to multiple outputs.

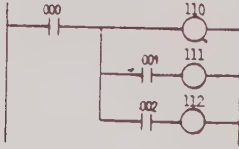


When the F-30 (MCS) instruction is programmed, the contents of the accumulator is stored in the CPU internal register, and operations for successive instructions are ANDed with the contents of the CPU internal register until the F-31 (MCR) instruction is reached. The F-31 (MCR) instruction indicates The range of AND operation applied.

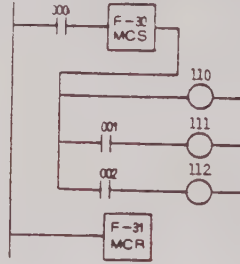
It will help simplify the program when the command operational condition is indicated in the block [] is compiled or many branches are set after the common operational condition.

NOTE-1: Do not directly connect the F-30 (MCS) derived bus line with OUT, TMR, and CNT instructions and application instruction.

(1) In case of the relay board

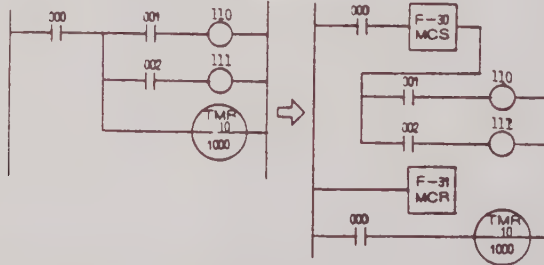


(2) MCS, MCR prohibited program

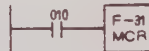


Instruction	
STR	000
F-30	
OUT	110
STR	001
OUT	111
STR	002
OUT	112
F-31	

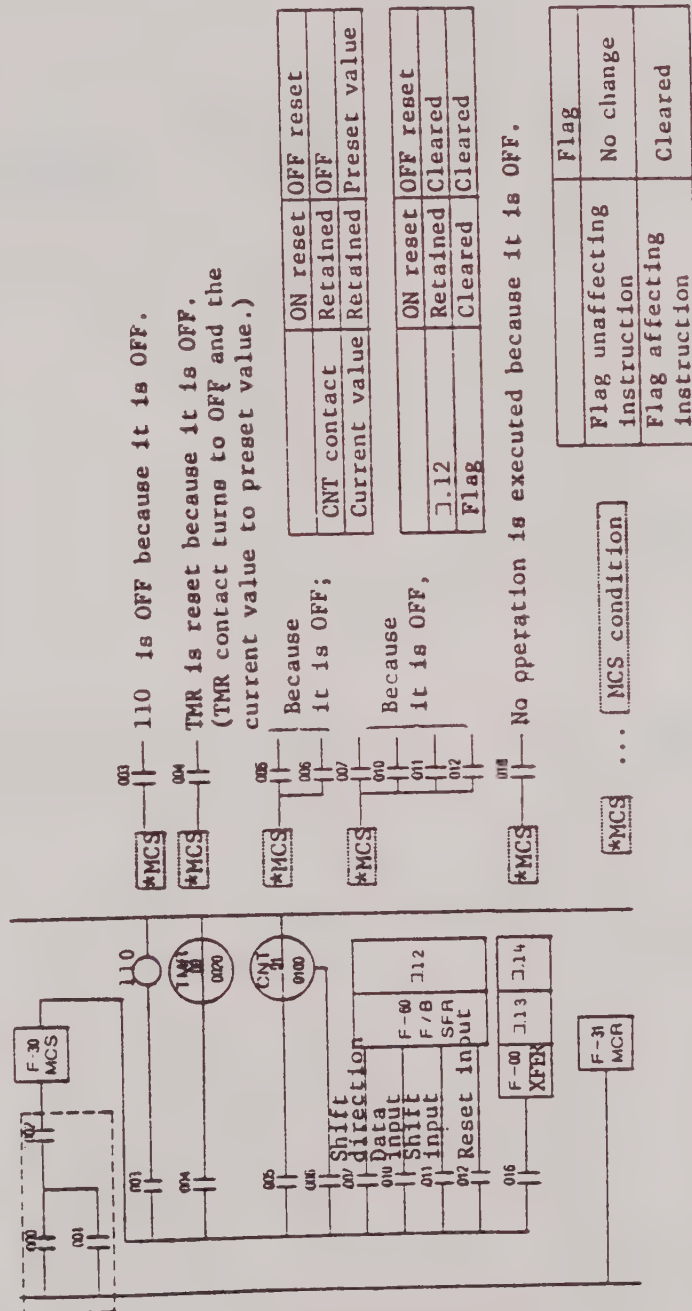
Program in the following manner:



NOTE-2: The F-31 (MCR) instruction is an unconditional instruction. It cannot be programmed as shown below.

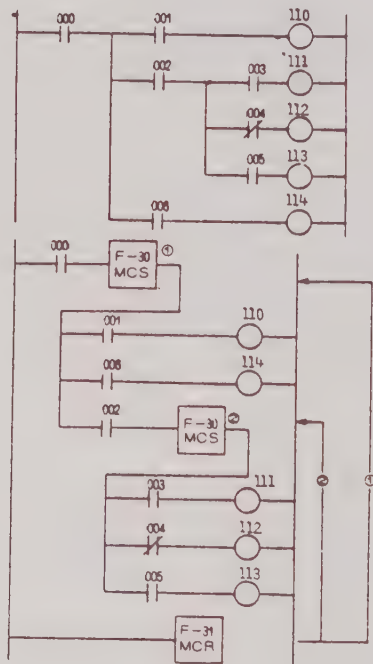


When the MCS condition (shown within dotted line) is OFF, instruction existing between MCS and MCR will be handled in the following manner.



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Another MCS may be used in-between MCS and MCR.



Relay board ladder chart shown (left) can be programmed in the following manner using MCS and MCR. However, there may be a need to change the program sequence. (*)

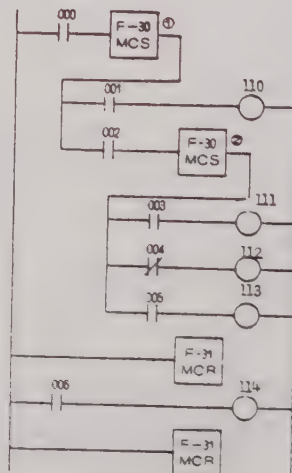
INSTRUCTION	
STR	000
F-30	
STR	001
OUT	110
STR	006 *
OUT	114 *
STR	002 *
F-30	
STR	003
OUT	111
STR NOT	004
OUT	112
STR	005
OUT	113
F-31	

* The F-31 (MCR) instruction indicates the termination of the preceding F-30 (MCS) instruction: 1 and 2 in the example.

NOTE-3: The desired circuit would not be established if programmed in the following way.

Instruction	
MCS-	STR 000
	F-30
	STR 001
	OUT 110
	STR 002
MCS-	F-30
	STR 003
	OUT 111
	STR NOT 004
	OUT 112
	STR 005
	OUT 113
MCR-	F-31
	STR 006
	OUT 114
MCR-	F-31

This MCR is insignificant. MCS of ① and ② has been terminated with this MCR.

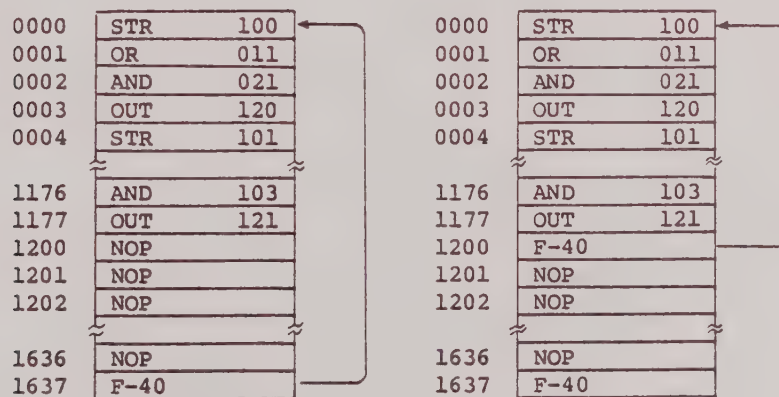


F-40	End Instruction
END	(END)

The F-40 instruction indicates the end of the program. As it has the highest priority, it will be effective even if it's between F-41 (JCS) and F-42 (JCR), and terminates the user program. There is no need of writing the END instruction, except for the following two cases; because it will be automatically set in the last address of the program memory when the memory is cleared.

(1) To accelerate the scan time

The scan time is the total I/O processing time plus the user program execution time. The user program execution time is the total time required to execute all instructions from the program address 0000 to the END instruction. The location of the END instruction is automatically written after memory clear. For example, assume that the last program address is 1177 (639th word); 1200 ~ 1636 are padded with NOP instructions and the END instruction is in 1637. Time is consumed for execution of all of the NOP instructions (2.17 microsecond per word). If F-40 is written in 1200, it accelerates the processing time because it does not execute those unwanted NOP instructions and the control can proceed to the next scan cycle.



(a) END (1637) after
mere memory clear

(b) F-40 (END)
written in 1200

(2) To perform partial program execution during testing, insert the F-40 instruction at the end of a sequence block, and execute that portion of the program. If the result was successful, that F-40 can be deleted.

NOTE-1: A multiple number of F-40's may exist when memory is added or the END instruction is written in (2). In this case, the user program terminates at the first F-40. Check the location of the END instruction before going into the actual operation.

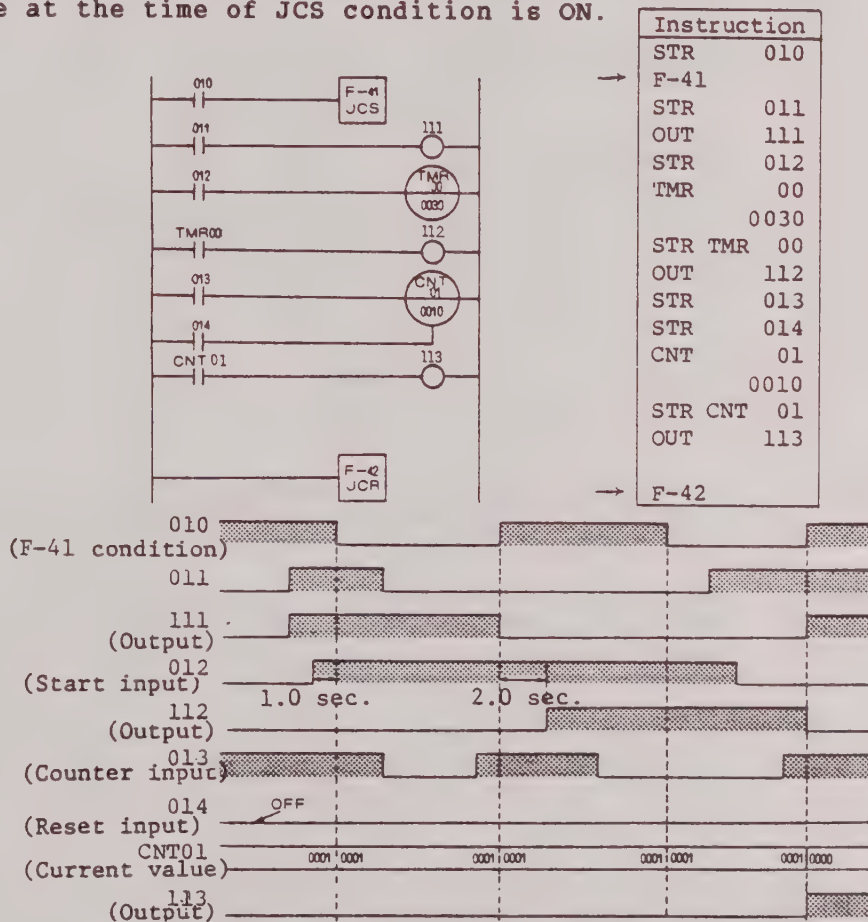
NOTE-2: The F-40 (END) instruction is unconditional. The following is prohibited.



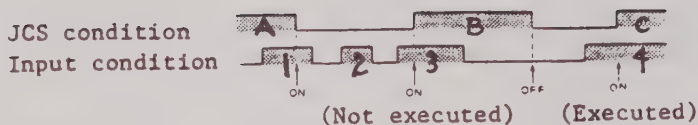
F-41	Set jump control
JCS	(Jump Control Set)

F-42	Reset jump control
JCR	(Jump Control Reset)

When the F-41 (JCS) condition is OFF, all instructions (except the END instruction) before the F-42 (JCR) instruction are not executed. If there was an instruction whose result should be stored in the data memory, it will not change the data memory contents. The data memory retains the state at the time of JCS condition is ON.



NOTE-1: Attention must be paid to the TMR internal clock (0.1-second clock), CNT counter input and application instruction input condition (OFF to ON transition in the input condition), and F-41 (JCS) condition ON/OFF timing.



Operation takes place when 1 goes high because the JCS condition is ON.

Operation will not take place when 2 goes high because the JCS condition is OFF.

Operation will not take place when 3 goes high because the JCS condition is OFF.

The JCS condition turns to ON while 3 is ON, but operation will not take place as it does not recognize that the input condition has changed from OFF to ON.

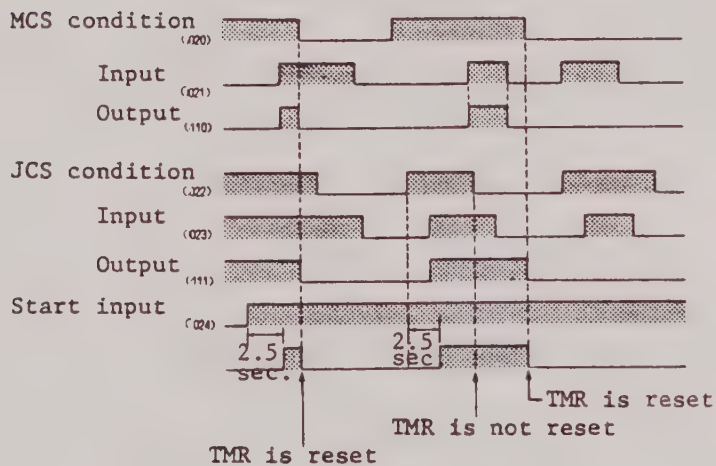
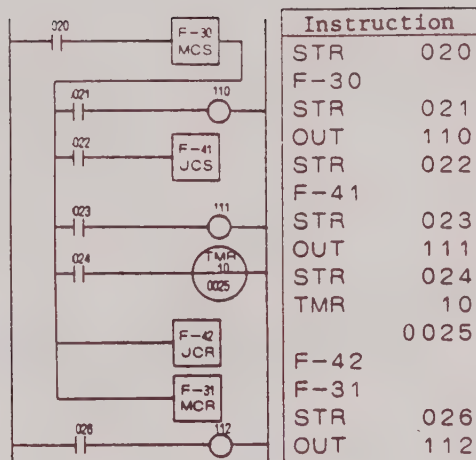
Operation will not take place when 4 goes high because the JCS condition is OFF.

The JCS condition turns ON while 4 is ON.

NOTE-2: Operation does not take place if the JCS condition is OFF when there is a flag-affecting instruction between F-41 (JCS) and F-42 (JCR). Instead, flags 654 through 657, are cleared.

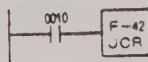
NOTE-3: The END instruction will be executed whether the JCS is ON or OFF; if there was a F-40 (END) instruction between F-41 (JCS) and F-42 (JCR), or if the user program execution is terminated and the control proceeds to the next scan cycle.

NOTE-4: F-41 (JCS) and F-42 (JCR) can be nested between F-30 (MCS) and F-31 (MCR). However, as MCS has a higher priority than JCS, it assumes the state of the MCS.



NOTE-5: It is not permitted to insert F-41 or F-42 between F-41 (JCS) and F-42 (JCR). On PP-0110 Programmers, "JCS ERROR" will be indicated during program check.

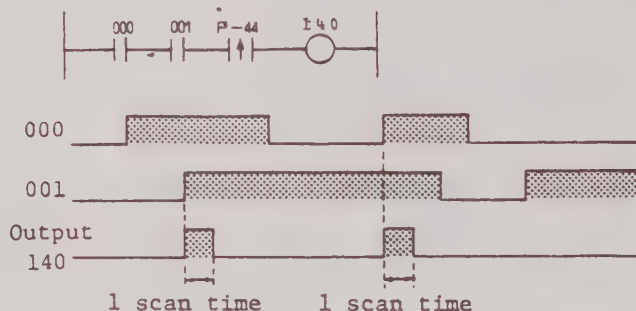
NOTE-6: The following kind of programming is not possible as F-42 (JCR) is an unconditional instruction.



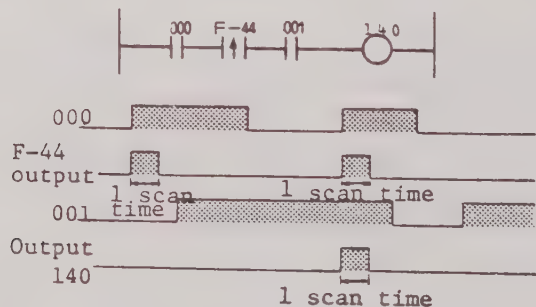
F-44 | Differentiate at ON
 - | ↑ | -

When the state of the accumulator just before the F-44 instruction changes from OFF to ON, one scan time pulse is generated.

Instruction	
STR	000
AND	001
F-44	
OUT	140

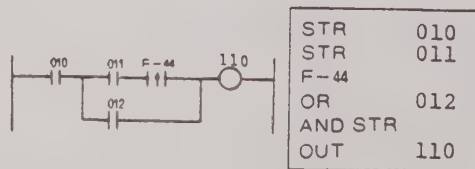


NOTE-1: Note that a different result is produced when the sequence of the F-44 program is changed from the above ladder chart. (Identical in the case of F-45.)



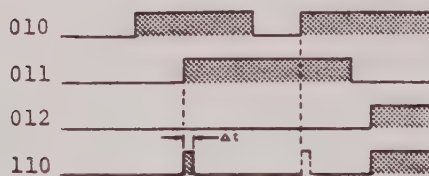
NOTE-2: F-44 may use any number of contacts.

NOTE-3: F-44 is the instruction that produces a signal that turns ON for one scan by detecting an OFF to ON change in the contents of the accumulator.



	Accumulator ACC	Stack register S ₁
STR 010	010	
STR 011	011	010
F-44	011 C-M	010
OR 012	011 012 C-M	010
AND STR	010 011 012 C-M	
OUT 110	010 011 012 C-M	

The accumulator goes ON for the scan cycle that 011 changed from OFF to ON.

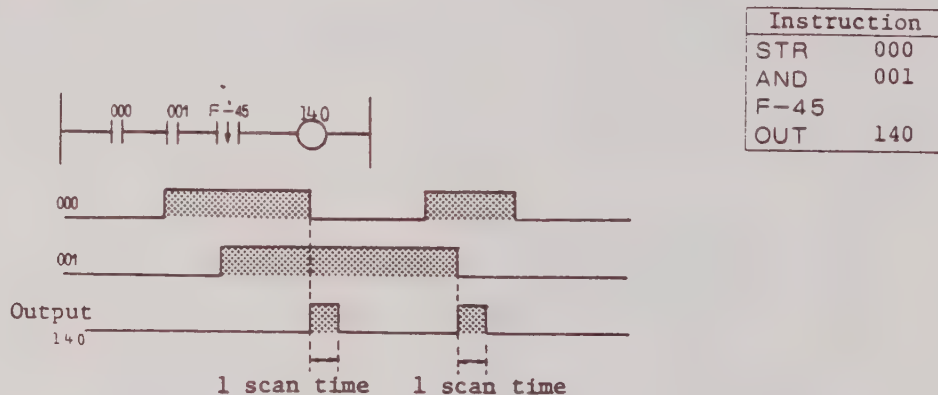


Δt : 1 scan time Differential signal is not issued.

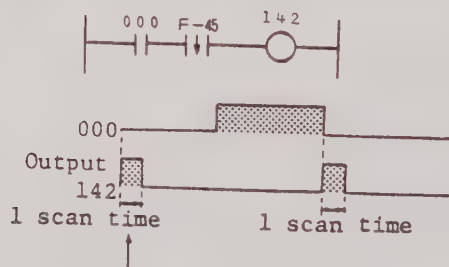
In the above example, a differential signal is not issued even if 010 has changed from OFF to ON when 011 is ON, because 010 is ANDed by the AND STR instruction.

F-45	Differentiate at OFF
- ↓ -	

When the state of the accumulator just before the F-45 instruction changes from ON to OFF, one scan time pulse is generated.

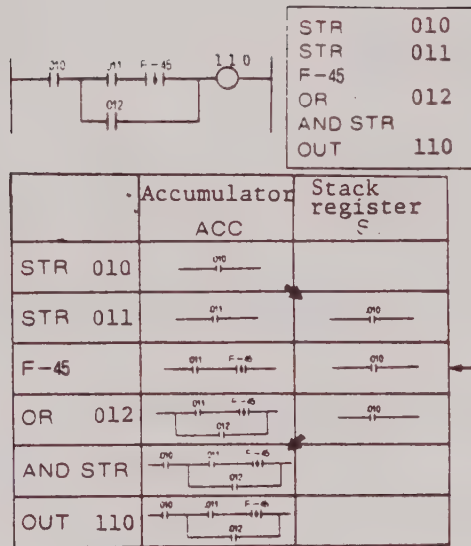


NOTE-1: Use of the F-45 instruction may sometimes operate immediately following program writing.

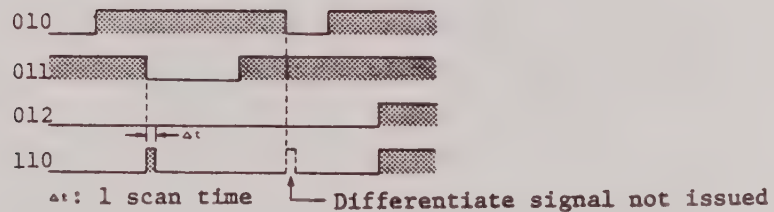


Output (142) turns ON if input (000) is OFF at the start of operation.

NOTE-2: F-45 produces a signal that turns ON for one scan by detecting an ON to OFF change in the contents of the accumulator.

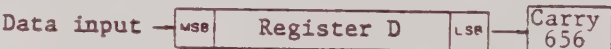


The accumulator turns ON for a scan when 011 changes from ON to OFF.



In the above example, differentiate signal is not issued even if 010 changed from ON to OFF when 011 is OFF, because 010 is ANDed by the AND STR instruction.

F-60	Shift register bidirectional
SFR	(Forward/Backward Shift Register)

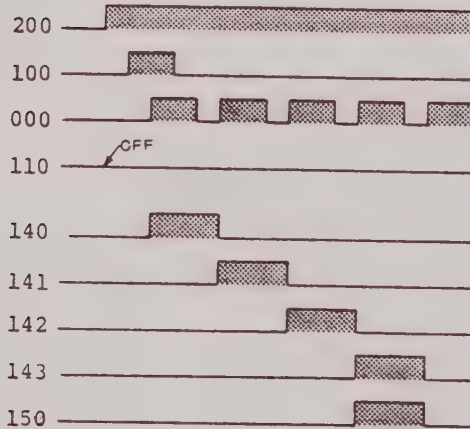
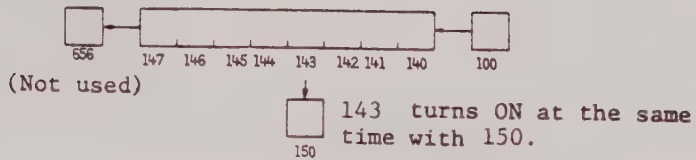
Symbol	 1) Shift direction input 2) Data input 3) Shift input 4) Reset input			
Function	The 8-bit data in register S is shifted to high order or low order bit positions according to the shift direction input.			
Operation	Shift direction input is ON:  Shift direction input is OFF: 			
Range of D applicable	.]00~].71(NOTE-1),			
Operational condition	When the reset input is OFF, bits are shifted at a rising edge of the shift input.			
Contents of D	Result is contained when the reset input is OFF. All bits are reset of OFF when the reset input is ON.			
TE Flag	Reset input (4)	Non-carry 654	Carry 656	Zero 657
ER	OFF	1 or 0	0 or 1	0 or 1
RA	ON	0	0	0
T				
I				
O				
N				

NOTE-1: .]65 ~ .]71 is the special relay area.

NOTE-2: Use the reset condition in the system memory (#202), to reset with OFF.

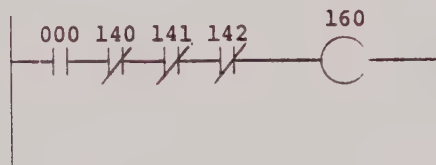
NOTE-3: State of the flag will be kept valid until the instruction that affects a next flag in that scan cycle is met.

(When 0200 is ON)

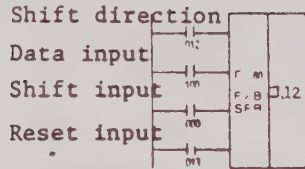


NOTE-1: Data is shifted in 144 ~ 147.

NOTE-2: When all of 140 through 147 are 0, the zero flag turns to 1.
The following program must be used to check if 140 ~ 142 are 0.

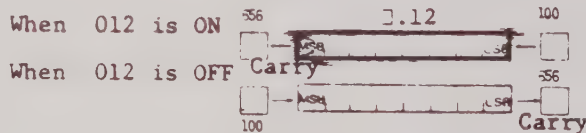


(Explanation)



When shift input 000 changes from OFF to ON, data are shifted in the following manner depending on the state of the shift direction input 012.

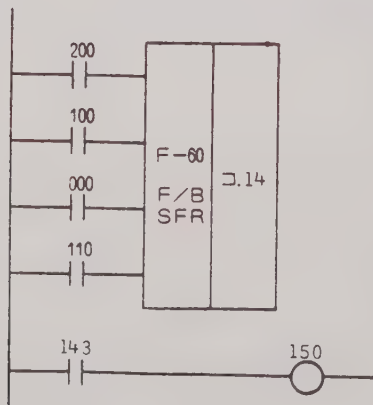
Instr.	
STR	012
STR	100
STR	000
STR	013
F-60	
	D.12



Input condition		.12 (before oper.)	.12 (after oper.)	Non-carry	Carry	Zero
		7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0	654	656	657
012	0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	●	0	●
100	0	● 0 0 0 ● 0 ● 0	0 ● 0 0 0 0 ● 0	●	0	0
000	┐	0 ● 0 0 ● 0 0 ●	0 0 ● 0 0 ● 0 0	0	●	0
013	0	0 0 0 0 0 0 0 ●	0 0 0 0 0 0 0 0	0	●	●
012	●	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	●	0	●
100	0	0 ● 0 ● 0 0 0 0	● 0 ● 0 0 0 0 0	●	0	0
000	┐	● 0 0 0 ● 0 0 0	0 0 0 ● 0 0 0 0	0	●	0
013	0	● 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0	●	●
012	0					
100	●	● 0 0 0 0 ● 0 0	● ● 0 0 0 0 ● 0	●	0	0
000	┐					
013	0	0 0 0 ● 0 0 0 ●	● 0 0 0 ● 0 0 0	0	●	0
012	●					
100	●	0 ● 0 0 0 0 0 0	● 0 0 0 0 0 0 ●	●	0	0
000	┐					
013	0	● 0 0 0 ● 0 0 0	0 0 0 ● 0 0 0 ●	0	●	0
013	●	0 0 ● 0 ● 0 0 0	0 0 0 0 0 0 0 0	0	0	0

0 = OFF ● = ON

REFERENCE: When .]xx is assigned for register D, the instruction forms an n-bit (n<8) shift register.



Application Instruction Notes

Source and Destination

When processing the instruction, data memory is handled in byte units. The register that contains the data before the operation is called the source (S) and the register in which the result is contained is the destination (D).

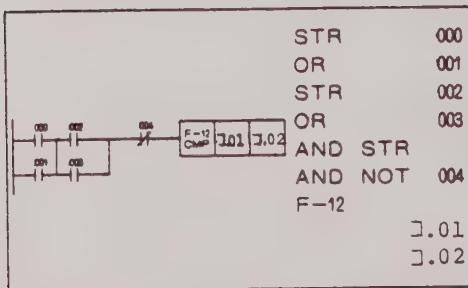


Application Instruction and the Stack Register

With the '085 System, each TMR, CNT, and the application instructions are processed by a high speed, general purpose CPU.

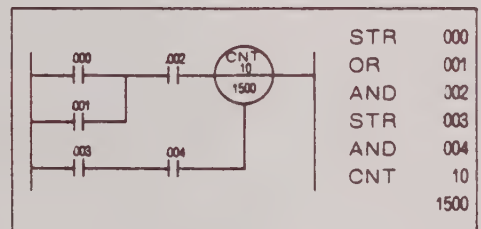
Application instructions except CNT and F-60 are executed having the contents of the accumulator for the operational condition as in the example 1 below. Example 2 illustrates CNT processing.

EXAMPLE 1



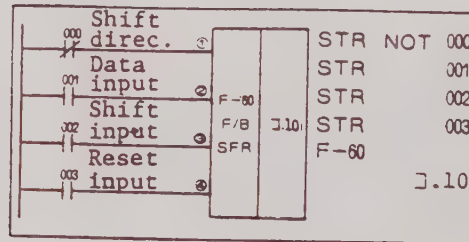
Instruction	Accumulator ACC	Stack register S _i
STR 000		
OR 001		
STR 002		
OR 003		
AND STR		
AND NOT 004		
F-12	Operation when condition is met	

EXAMPLE 2



Instruction	Accumulator ACC	Stack register S _i
STR 000		
OR 001		
AND 002		
STR 003		
AND 004		
CNT 10 1500	Reset input	Counter input

With the F-60 instruction, the accumulator and the stack registers ($S_1 \sim S_3$) become the operational condition.



Instr.	Accumulator ACC	Stack register		
		S_1	S_2	S_3
STR NOT 000	000 			
STR 001	001 	000 		
STR 002	002 	001 	000 	
STR 003	003 	002 	001 	000
F-60	Reset input ④	Shift input ③	Data input ②	Shift direction ①

Fig. 4-47 Accumulator to Stack Register Shifting

Operational Condition

The operational condition of an application instruction with which execution of the operation is determined, may be a complex serial/parallel circuit. Because of the processing of the system, you are not limited to a single contact ON/OFF condition.

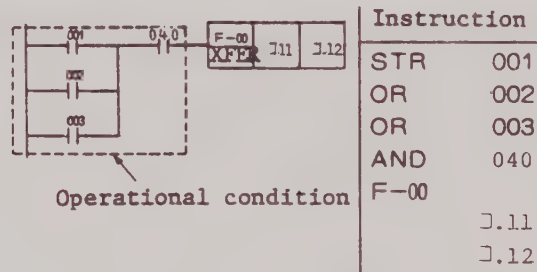


Fig. 4-48 Operational Condition

If the operational condition is the same, programming may also be developed successively as shown below.

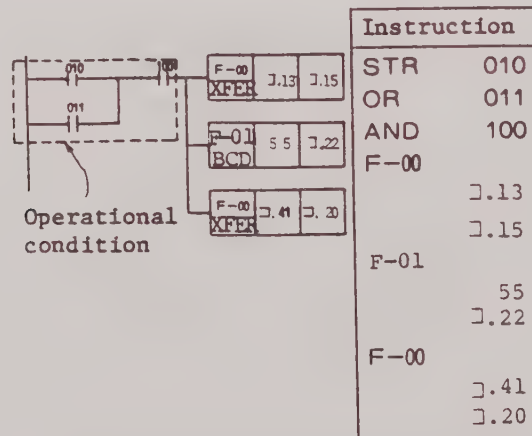


Fig. 4-49 Another Operational Condition Example

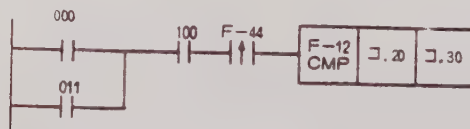
When the operational condition is satisfied for the application instructions, the following types of processing result.

(F-30, F-31, F-40, F-41, and F-42 are exceptions)

1. Those with which operation takes place at each scan cycle, so long as operational condition is met. (F-12, Compare Register w/Register)
2. Those with which operation takes place only at the first scan cycle when the operational condition is met.

With instructions of item #2 above, the ON/OFF state of the operational condition in the preceding scan cycle is compared with the ON/OFF state of the operational condition at the current scan cycle. If the preceding state is OFF and the current state is ON, the operation takes place as if the operational condition changed from OFF to ON.

NOTE: In case the operation must be executed only when there is an OFF to ON transition in the operational condition with respect to F-12, the F-44 instruction (rise edge differentiate instruction) must be used.



If the operational condition is not satisfactory, no operation takes place and the register on the destination side remains unaffected. It includes scan cycles after ON for the instruction that the operation is executed upon only when the operational condition changes from OFF to ON. The flag is cleared in the case of instructions affecting the flag.

Instructions using	F-00, F-01, F-07, F-44,
differential memory.	F45, F-60

Commands may be executed within one scan time immediately after write, deletion, or insertion of the instruction that uses the differential memory.

Using the High Speed Counter (085B-E)

High Speed Counter Processing

Pulses to the high speed counter can be accepted at any time during operation. Depending on the state of the high speed counter enable relay (662) and the high speed counter reset relay (663), changes may take place in the current value area (].70,].71). Only when the high speed counter enable relay (662) is active (ON), pulses are added in the current value area. If the relay is inactive (OFF), the contents of the current value area remain unaffected. When the high speed counter reset relay (663) is active (ON), the current value area will be reset to 0000. A BCD 4 digits of the current value is stored in the current value area.

].71				].70			
7	6	5	4	3	2	1	0
4th digit				3rd digit		2nd digit	1st digit

The following shows the processing flow chart.

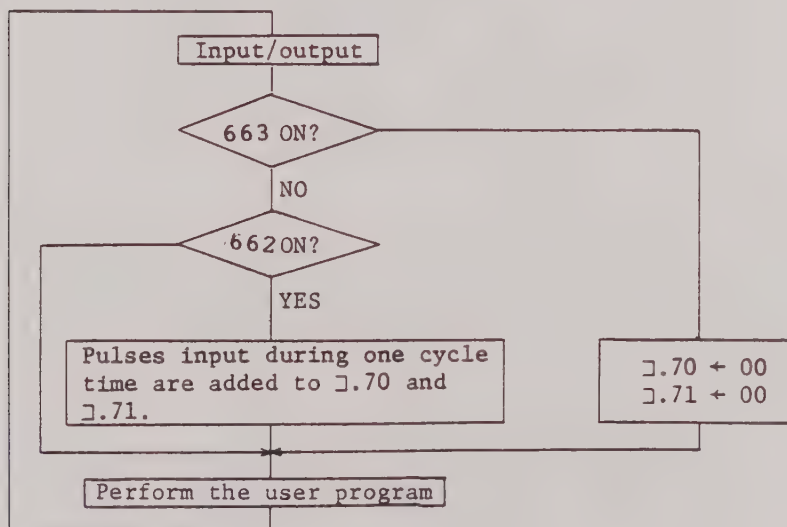


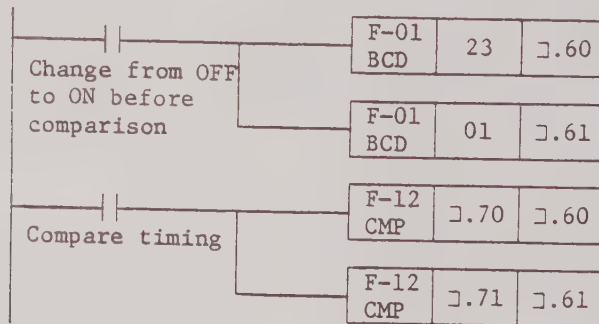
Fig. 4-50 Hi-Speed Counter Processing Flow Chart.

Comparison of the Current Value vs Preset Value

The current value can be compared with the preset value using the register compare instruction (F-12). The results will be stored in the carry flag, zero flag, and non-carry flag. But consider the following;

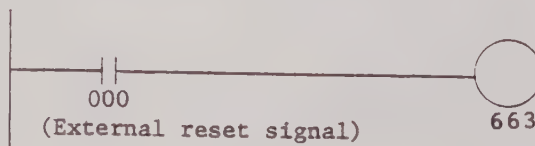
Since independent use of the F-12 instruction compares only a single byte, the same two instructions must be executed in succession in order to compare four digits (2-bytes) of the current value. (Refer to Double Length Operation.)

Because comparison with the direct constant number is not possible with independent execution of the F-12 instruction, the constant must be transferred to the register using the F-01 instruction before performing comparison.



Resetting the Current Value

It is possible to reset the current value to 0000 using the high speed counter reset relay (663). To reset with an external signal, reset must be done via the input module.



Note

When manually entering a Reset using the Programmer, the counter is reset for one scan only and the counter resumes counting from 0. When the Reset is used in a program however, you can reset and hold the counter at 0 for any period desired.

Presetting

It is possible to preset the current value when the current value area is specified in the operand of the transfer instruction (such as F-00).



In the above example, the current value is preset to 0123 at an OFF to ON transition of the input 010.

SUMMARY OF INSTRUCTIONS

Instruction	Symbol	Word size	Function	Performance	Condition	ACC	Stack	Flag	Execution time (μs)
STR		1	Operation starts with the a-contact and intermediate result is stored.			↑	S1 S2 S3 S4 S5 S6 S7 S8	0 0 0 0 0 0 0 0	5.43
STR NOT		1	Operation starts with the b-contact and intermediate result is stored.			↑	S1 S2 S3 S4 S5 S6 S7 S8	0 0 0 0 0 0 0 0	5.43
AND		1	Logical AND			↑	S1 S2 S3 S4 S5 S6 S7 S8	0 0 0 0 0 0 0 0	5.43
AND NOT		1	Logical AND NOT			↑	S1 S2 S3 S4 S5 S6 S7 S8	0 0 0 0 0 0 0 0	5.43
OR		1	Logical OR			↑	S1 S2 S3 S4 S5 S6 S7 S8	0 0 0 0 0 0 0 0	5.43
OR NOT		1	Logical OR NOT			↑	S1 S2 S3 S4 S5 S6 S7 S8	0 0 0 0 0 0 0 0	5.43
AND STR		1	Logical AND with the intermediate result			↑	S1 S2 S3 S4 S5 S6 S7 S8	0 0 0 0 0 0 0 0	5.43
OR STR		1	Logical OR with the intermediate result			↑	S1 S2 S3 S4 S5 S6 S7 S8	0 0 0 0 0 0 0 0	5.43
OUT		1	Output of operational result			↑	S1 S2 S3 S4 S5 S6 S7 S8	0 0 0 0 0 0 0 0	14.1
TMR		2	Timer (decremental) (1) Start input (2) TMR number (00~57) (3) Preset value (0.1~199.9sec) Internal clock 0.1-second	Current value is decremented by one every 0.1 second while the start input is ON, and makes the TMR contact ON with the current value at 0.	Start input ON		S1 S2 S3 S4 S5 S6 S7 S8	0 0 0 0 0 0 0 0	99.8[83.5]
CNT		2	Counter (decremental) (1) Counter input (2) Reset input (3) CNT number (00~57) (4) Preset value (1~1999) NOTE-3	Current value is decremented by one at the rising edge of the counter input while the reset input is OFF, and makes the CNT contact ON with the current value at 0.	Counter input		S1 S2 S3 S4 S5 S6 S7 S8	0 0 0 0 0 0 0 0	98.7[82.5]

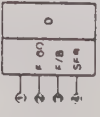
(1) Non-carry (654) (2) Carry (656) (3) Zero (657)
 (4) Value in parenthesis is when not executing

Summary of Instructions (cont.)

Instruc- tion	Symbol	Word size	Function	Performance	Condi- tion	ACC	Stack								Flag	Execution time (μs) ④
							S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈		
F-00		3	One byte transfer between data registers	S + D	f											66.2[59.6]
F-01		3	Transfer BCD constant	(BCD) n + D n=00~99	f											66.2[59.6]
F-07		3	Transfer decimal constant	(Decimal) n + D n=000~255	f											66.2[59.6]
F-12		3	Compare register with register	S ₁ <=> S ₂	ON										↑	68.3[41.2]
F-30		1	Set master control	F-31 (operation up to MCR is ANDed with MCS condition)												13.0
F-31		1	Reset master control	Indicates the termination of master control												9.76
F-40		1	END instruction	Indicates the end of operation and the control proceeds to a next scan cycle												8.68
F-41		1	Set jump control	Operation up to F-42 (JCR) is not executed when the input condition is OFF												15.2
F-42		1	Reset jump control	Indicates the termination of jump control												9.76
F-44		1	Differentiate at ON	Input scan time		↑										47.7

①: Non-carry(654) ②: Carry(656) ③: Zero(657)
④: Value in parenthesis is when not executing

Summary of Instructions (cont.)

Instruction	Symbol	Word size	Function	Performance	Condition	ACC	Stack	Flag	Execution time (μs)
F-45		1	Differentiate at OFF	Input scan time 		↑	S ₁ S ₂ S ₃ S ₄ S ₅ S ₆ S ₇ S ₈	①②③	55.3
F-60		2	Shift register bidirectional (1) Shift direction input (2) Data input (3) Shift input (4) Reset input NOTE-3	(1) When shift direction input is ON Carry flag  Data input  (1) When shift direction input is OFF Data input  Carry flag 	Shift input }			↑↑ ↑↑	97.6[80.2]
NOP		1	Not operated instruction	Moves to a next step without any action					2.17

①: Non-carry(654) ②: Carry(656) ③: Zero(657)
④: Value in parenthesis is when not executing

NOTE-1: Execution may vary depending on data. The number in the table shows the maximum execution time.

NOTE-2: An error will be met in the TMR and 0.1-second clock when the scan time extends beyond 160msec.

NOTE-3: Reset condition for CNT, and F-60, depends on how the system memory (#202) has been programmed.
(000...ON reset, 001...OFF reset)

↑ ... May vary as affected by the operation.

A ... Stores the contents of the accumulator.

0 ... Turns to 0 as a result of operation.

↓ ... Executed as a low to high transition (OFF to ON) of the input.

When the column of the ACC, Stack (S₁~S₈) and Flag is a blank, no influence is given by the operation.

SECTION 3 PROCESSING NOTES

The Operational Flow Chart for the PC-0085 controller is shown below:

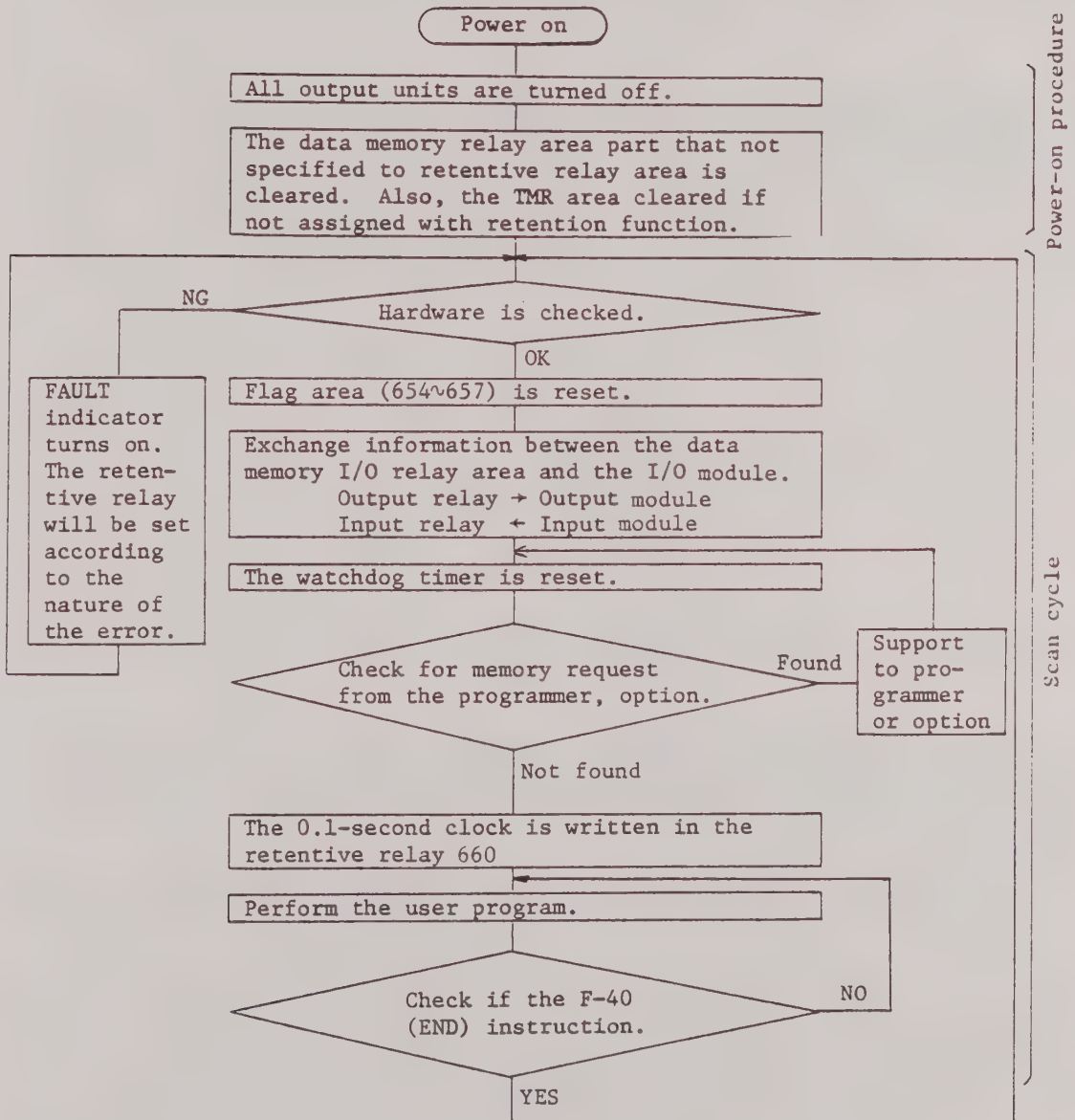


Fig. 4-51 PC-0085 Operational Flow Chart

Power-On Procedure Following Power Failure

When the power is turned on, the power failure signal remains in a low state for about 10 ms after the complete rising edge of the 5V supply. The machine then starts to initialize the data memory. After initialization, the data memory is set according to the following conditions:

Data Memory	Address	State after the initialization
Input relay	000~107	By entering a number in system memory address 200, the starting address of latched relay is specified. Relays numbered below the entered number will go OFF during power failure. All relays above the number remain latched in their last state during power failure. It has been factory set to 060 initially since the retentive relay address is 600.
Output relay	110~167	
Auxiliary relay	170~577	
Retentive relay	600~647	
TMR, CNT	00~57	TMR: By setting system memory address 201 to 000 or 001, either the preset (starting) value of the timers are returned or the current value is maintained during a power fail.
		000 - The timer returns to preset (starting) value after power fail.
		001 - The value is maintained during power fail and timer resumes from that point.
		CNT: The CNT retains the last value before the power failure.

At power-on, output data latch of all output modules will reset and all outputs turned OFF, prior to the above initialization process. After the data memory is initialized, the data memory input/output relay area changes by the input and output execution in the first scan cycle where:

- (1) Input relay area to which the input module is interfaced turns ON or OFF according to the ON/OFF state of the input device (such as the limit switch) connected to the input module.
- (2) Input relay area to which no input module is interfaced, does not change from the state of the initialization.
- (3) Output relay area does not change from the state of the initialization until the user program execution phase.

Scan Cycle

The machine goes into the scan cycle upon completion of the power-on procedure. Each scan cycle consists of hardware check to the end of program where the F-40 END instruction is written. When the program execution is completed, the control returns to the hardware check and repeats the same procedure. The time required to execute this one cycle is called the scan time.

(1) Hardware checks:

Self-diagnostics are carried out to check if the control module hardware is working properly.

- a. RAM test
- b. Watchdog timer
- c. Memory check
- d. Power supply failure
- e. Option failure
- f. Battery failure
- g. I/O failure

(2) Clearing of flags

Some data processing instructions affect flags according to the operational result. Flags are cleared prior to user program execution at each scan cycle.

(3) I/O processing

Data is exchanged between I/O module and the data memory. Execution starts from the I/O module having the smallest I/O relay number, to the next smallest, etc.

The ON/OFF state of the input device connected to the input module is written in the data memory address corresponding to the input point. The contents of the data memory stored in the address corresponding to the output module are latched in the output module so that the output module changes to ON or OFF. At the end of the I/O processing the written data, via the loopback connector, is read to verify if correctly received. This test is not passed unless the loopback test connector is installed.

In the first cycle after power on, the contents of the data memory initialized by the power-on procedure are written in the output module. In cycles thereafter, the operational result of the preceding cycle is written in the output module.

The number of connected I/O modules are checked at power on and input and output operations are carried out according to the determined number. This check is not performed unless the loopback connector is installed. If the loopback connector is not installed, the maximum number of modules (9 input modules and 6 output modules) will be assumed to be connected.

Input locations where no input device is connected will be processed as OFF during the I/O processing. These relays cannot be used for auxiliary relay. However, if an output is not connected to an output device it can be used for auxiliary relay, but the contents of the data memory are written in the output module during the I/O processing and the corresponding LED lights up on the output module when active.

If these areas are used for auxiliary relay, a great deal of program revision may be required in order to use an I/O device in this area in future.

(4) Watchdog timer

The watchdog timer is a check to determine that the CPU is operating correctly according to the internal process flow. The CPU resets the watchdog timer for each scan cycle that is executed normally. When an error occurs in the scan time, a time out signal is applied from the watchdog timer (the CPU does not reset the watchdog timer). This turns the RUN indicator on the Controller OFF and the FAULT indicator turns ON instead.

(5) Processing of a request from the Programmer or Option Module

Performs monitoring and preset value changes entered from the Programmer or Option Module. When there is a memory request to the Controller from the Programmer or other option module (the signal requesting write or read to/from the data memory and user program memory in the Controller), the Controller CPU will support the memory as requested.

(6) Set/Reset of the 0.1- second clock (660)

The software created ON/OFF state of the .01-second clock is set in the retentive relay 660.

(7) User Program Processing

The program is read from the top of the user program area to perform the operation, unless a parity error is encountered. As the program is entered by the PP-0105 Programmer (or the PP-0110), parity is generated and added to each word. At the start of execution, parity is examined. When a parity error is encountered, the CPU control then proceeds to the parity error processing. When a change in the user program memory can be discovered by this parity check, the Controller does not execute the program.

When no parity error exists, the operation takes place according to the contents of the user program. For operation with STR, STR NOT, AND, AND NOT, OR, OR NOT, AND STR, and OR STR, the result is stored in the accumulator and stack register. For OUT, TMR, CNT, and almost any application instruction (F-xx), the result is stored in the data memory.

Prior to execution of the user program, the ON/OFF state of the input module is batch transferred to the data memory in the "I/O process" and the contents of the data memory are referred to in executing instruction. This eliminates input racing.

With instructions that store the operational result in the data memory (like the OUT instruction), the result is stored each time it is executed. However, the state of the output unit does not change until the output is processed on the next scan cycle. Also, when such an instruction is followed by an instruction which uses respective data memory as contact, the operation takes place on the basis of the contents that were revised by the OUT instruction.

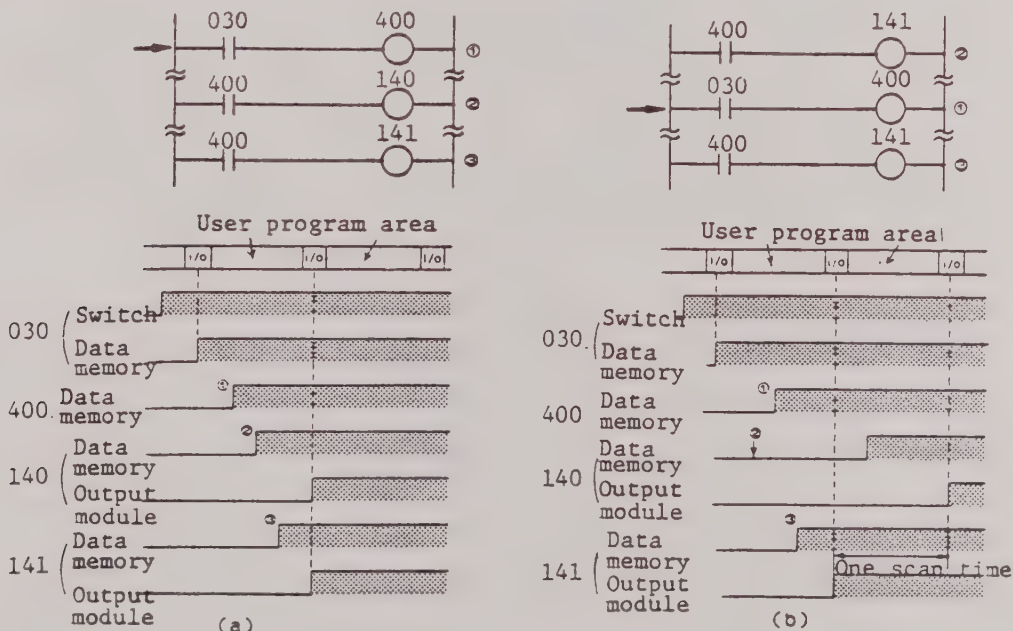
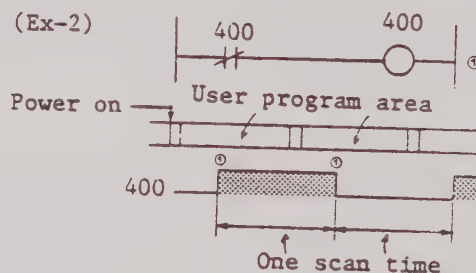


Fig. 4-52 Program Data Manipulation Example

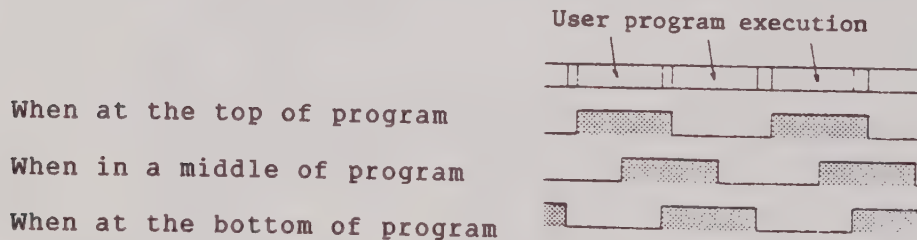
If the program write sequence is changed as in (a) and (b) of the previous figure, it may produce a different result. There would be no difference between (a) and (b) with the relay board for parallel operation. But, with the sequence controller which performs serial operation (almost all currently available sequence controllers are this type), the above mentioned phenomenon may appear. Thus, attention must be given to the following point in using the auxiliary contact of the coil:

NOTE

The change in state of the auxiliary contact is written before the change of the coil's state is recognized on the next scan.



The figure above on the other hand, uses the theory "change of state in the auxiliary contact written before the coil, takes place the next scan after the state of the coil changed". ON/OFF is repeated at every scan cycle (oscillation circuit). This pulse may be used for the basic clock of flashing circuit or operation start signal at every other single scan. As shown in the timing chart below, the ON/OFF timing may vary depending on the location of the oscillation circuit program in the user program. Care must be taken when using this pulse for an operation start signal.



When the user program uses the same relay number repeatedly for the same coil, the last state of the coil is left in the data memory at the end of the program. It is then written to the output unit during I/O processing during the next scan cycle. Consequently, it may evoke an operation that is not part of the desired results of the program.

Repeated use of the same coil will be displayed as an error message when subjected to a program check.

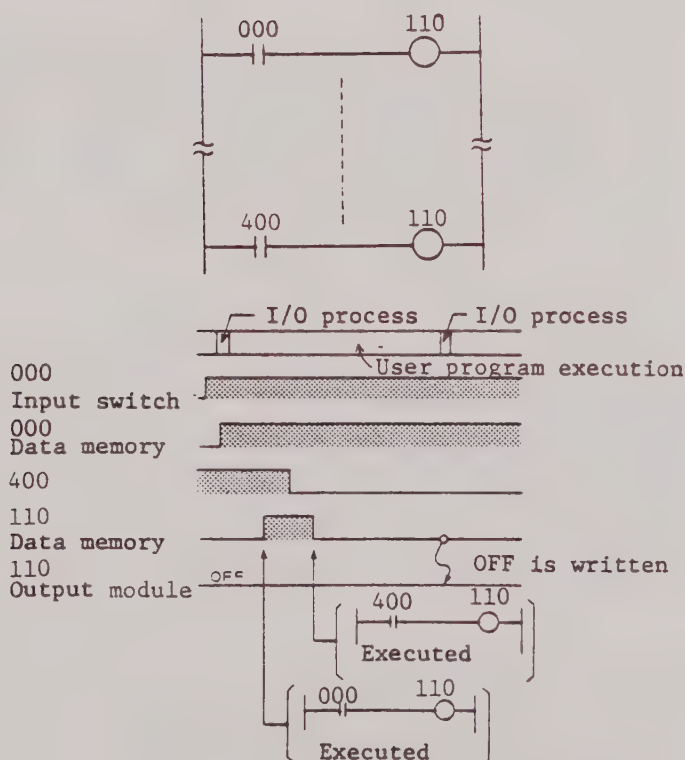


Fig. 4-53 Repeated Use of a Coil Example

Scan Time

The time required to complete everything from the hardware test to the execution of the F-40 END instruction is called the scan time. The approximate time can be obtained by using the equation shown below. The time required for the execution of a request from the programmer is not included in the scan time, because it varies depending on existing requests and the contents of processing. The time required for the hardware test, writing the 0.1-second clock to retentive relays, or resetting the flags can be disregarded because they are relatively short when as compared with other processing times.

$$1 \text{ scan time } (T) = \text{I/O processing time } (t_1) + \text{user program processing time } (t_2)$$

NOTE

In order to set the ON/OFF state of the contact into the data memory, more than one scan is required for the ON or OFF time of the input logic side. If the ON/OFF time on the input unit logic side were shorter than one scan cycle, it may or may not be read into the data memory.

I/O Processing Time (t_1):

This is the time required for the CPU to read the input information and write to the output modules. The I/O processing time can be determined by the number of input and output modules.

$$t_1 = \text{number of input units} \times t(\text{in}) + \text{number of output unit} \times t(\text{out})$$

$$\begin{aligned} T(\text{in}) &= 67.3 \text{ us} \\ t(\text{out}) &= 58.6 \text{ us} \end{aligned}$$

User Program Execution Time (t_2):

This is the total time required for execution of all instructions from the program address 0000 to the END (F-40) instruction. The execution time of the application instructions may vary depending on their inputs, preset values, and placement within the program.

END Instruction (F-40)

When the program memory is cleared, the entire program memory area is filled with NOP instructions and the F-40 (END instruction) is written into the last program address. If the F-40 instruction is written into the address immediately after the last program step, the scan time will be as short as possible. Each NOP instruction execution time takes 2.17 us.

Data Processing Instructions and Flags

Flag Types

Flags are used to reflect the operational result. There are three kinds of flags for the 085X; non-carry, carry, and zero flags. They are assigned to three bits of data memory 654, 656, and 657.

<u>Non-carry</u>	<u>Carry</u>	<u>Zero</u>
654	656	657

The flags are set according to the operational result of the instruction, when the operational condition for that instruction has been met. The flag is cleared when the operational condition is not satisfactory for that instruction. The flags are not changed when executing other instructions that do not use these relay areas.

Instructions Affecting Flags

The following two instructions set flags active according to the operational result.

1. F-12 Compare Register
- 2 F-60 Compare Register Bidirectional

Instructions other than above do not affect flags.

How to Retain Flag

Flags set according to the operational result may be changed or cleared by the execution of the flag affecting instruction in that scan cycle. In the next scan cycle, the flag is cleared before execution of the user program. If the flag is to be retained in its current state, you must write the state of the flag into a coil such as the auxiliary relay immediately following the respective instruction. This retains the flag state until the execution of the respective instruction in the scan cycle.

- 1) Program that set 145 ON when $\square.11 \geq \square.13$ or $\square.12 \geq \square.13$.

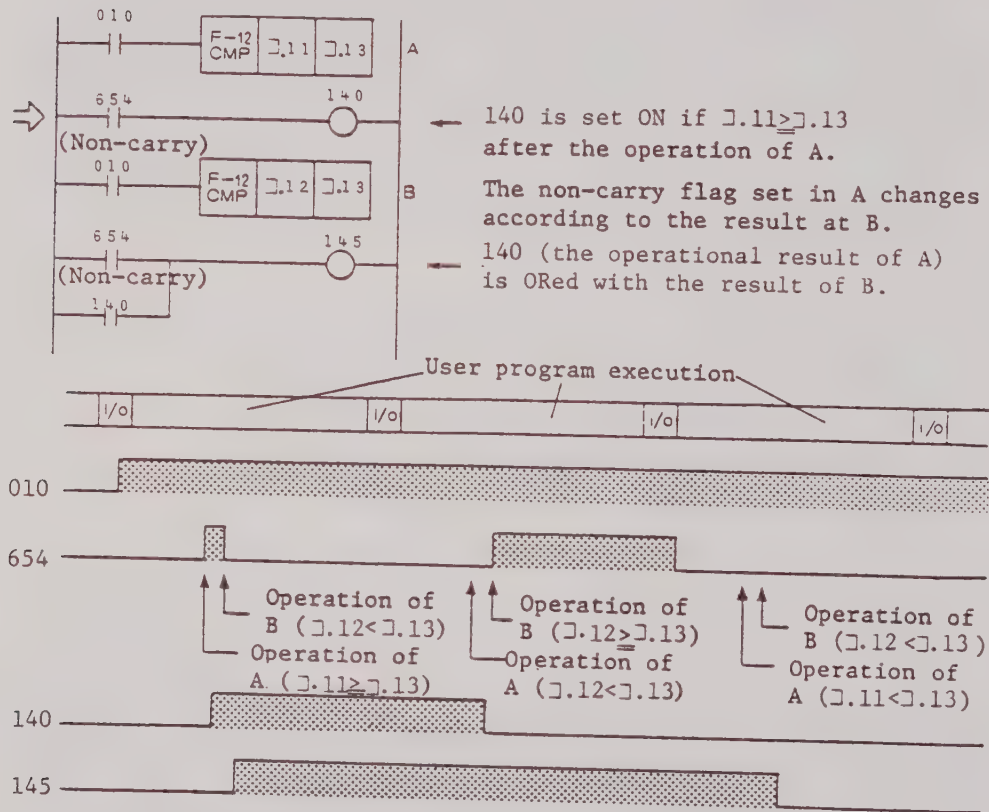


Fig. 4-54 Flag Setting Example

When the flag state is monitored by the Programmer, it is not possible to visually check the state of the flag because the flag can only be retained for a single scan cycle by storing the state of the flag in the coil as in the example above.

Double Length Operation

1. The F-12 instruction permits operation of more than two bytes.
2. Programming double length operation
With the double length operation, a carry over or a carry down occurring in a lower order digit is reflected in processing the next digit. It should be programmed from a low order digit in succession to the operational condition.

(Ex-1)

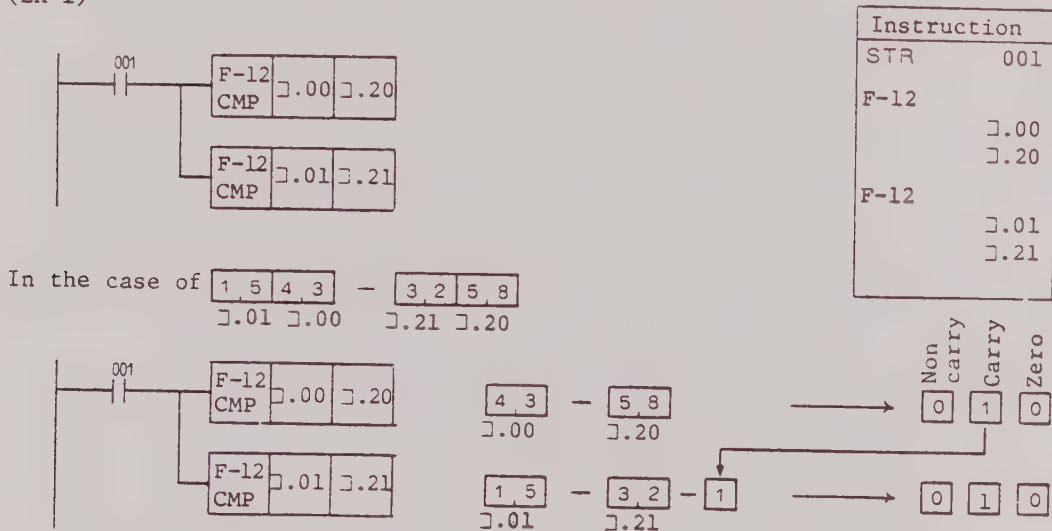


Fig. 4-55 Double Length Operation Example

The carry flag in a low order digit is compared with a next high order digit during the operation.

Programming in the following way would not perform the double length operation.

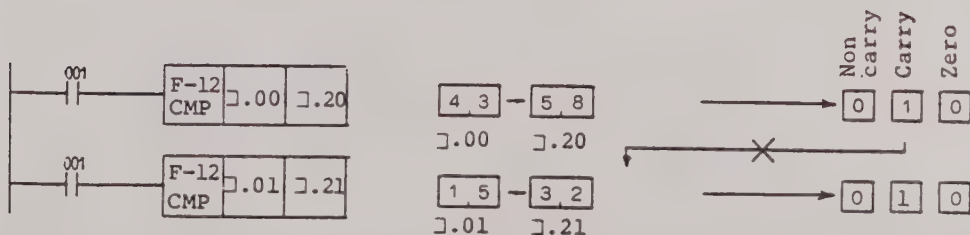
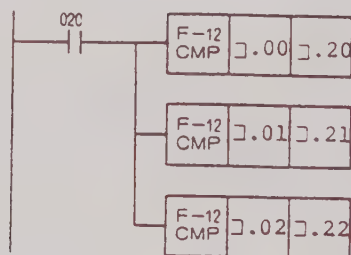


Fig. 4-56 Double Length Operation Error

(Ex-2) Double length operation above three digits is also possible in a similar manner.



(Comparison of three bytes data)

Fig. 4-57 Double Length Operation Above Three Digits

Internal Processing During the Double Length Operation

1. For the operation of F-12 instruction that appears after the operation condition, the operation takes place without including the state of the flag before that.
2. If there are some F-12 instructions encountered during execution of the common operational condition, the following occurs:
 - a. Execution occurs including the state of the carry flag immediately before.
 - b. The state of the zero flag immediately before is ANDed with the state of the zero flag after the operation of the respective instruction. If both are 1, the zero flag is set.
3. The double length operation takes place even if there is no flag affecting instruction between the F-12 instruction and next F-12 instruction.

Commands Using The Differential Memory

The total number of instructions that use the differential memory are listed below:

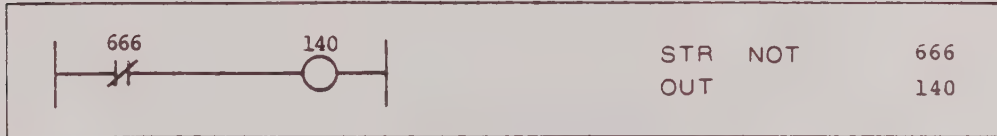
F-00
F-01
F-07
F-44
F-45
F-60

A command may be executed within one scan time immediately after write, deletion, or insertion of the instruction using the differential memory.

SECTION 4 PROGRAMMING EXAMPLES

Basic Instruction Applied Circuits

Ever-on circuit:



Because the retentive relay 666 is the contact that remains OFF at all times, coil 140 is always ON. If system memory #203 has been programmed where all outputs becomes OFF during halt, this circuit can be used as the RUN indicator for the 085X when the programmable controller stops after a mode change to the program mode or as a result of self-diagnosis.

NOTE-1: It is possible to use the system memory # 203 for the output retention during of the P.C. When the system memory has been cleared, it goes into the state of 000 (Octal) which retains outputs when stopped. (The system memory has been factory cleared). In the above example, entering 001 in the system memory #203 resets outputs when the programmable controller is stopped.

[2] Generating a single pulse at power on:

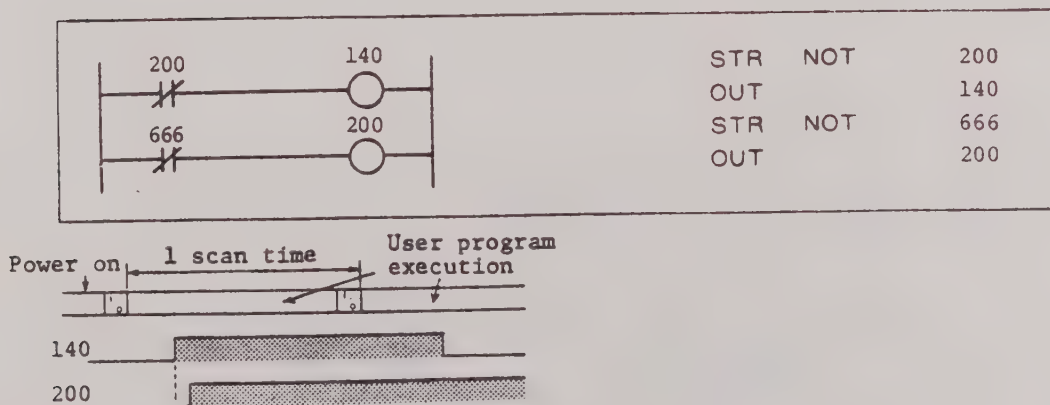


Fig. 4-58 Generating a Single Pulse at Power ON

NOTE: No pulse is generated when the program sequence is changed.

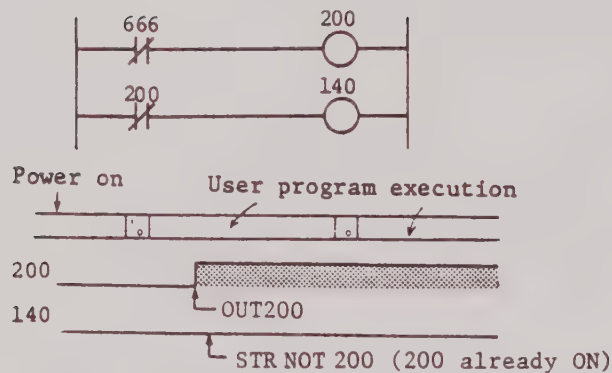
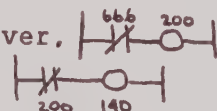


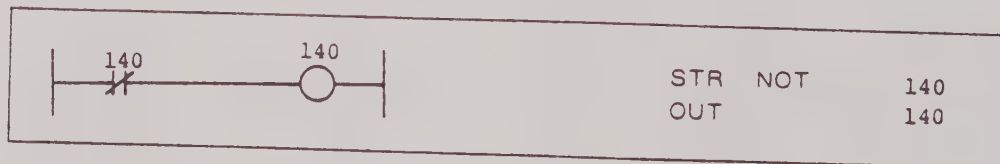
Fig. 4-58 Generating a Single Pulse at Power ON (cont.)

NOTE-1: No pulse is generated when 200 is in the latched function (system memory #200) since 200 turns ON upon preceding power on and retains ON during a power failure.

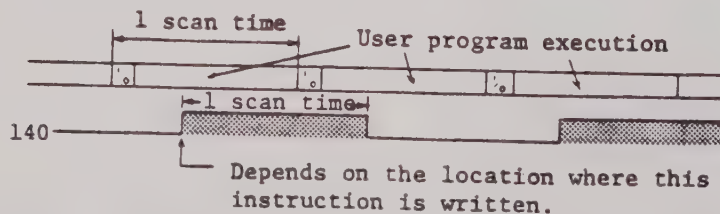
NOTE-2: This pulse may be used to clear registers at power on and to preset constants. The above program must be written before the instruction by which register is cleared.

(However, after ) may be written any place

Oscillation circuit:



ON and OFF are repeated at every scan.



This pulse is used for the basic clock of the blink circuit or operation start signal at every other scan.

NOTE: Depending on where the instruction is written in program steps, determines which point of the scan cycle it changes state.

CAUTION: Caution is required when this pulse is to be used for the start signal for operation.

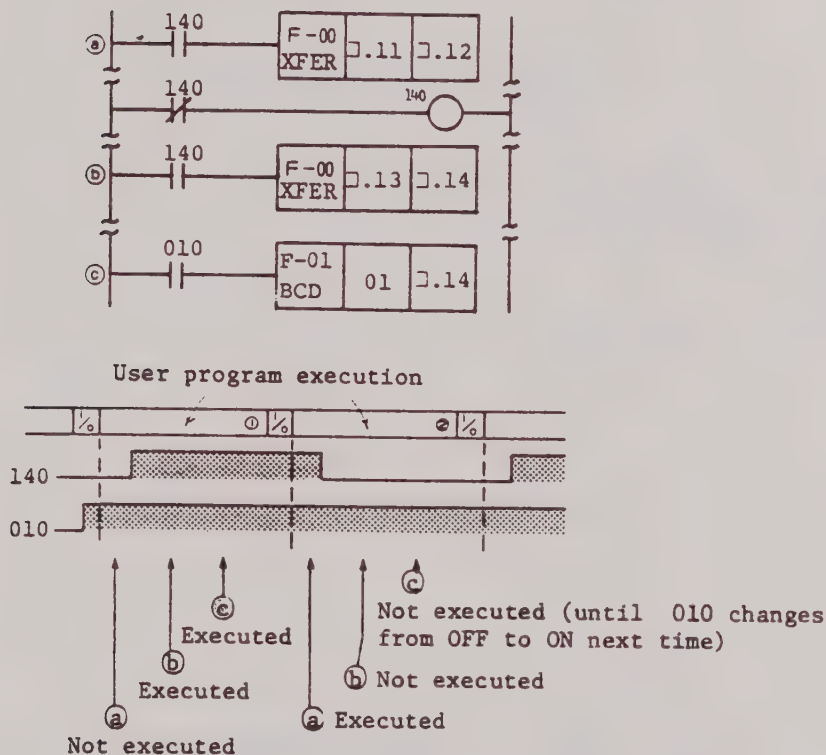
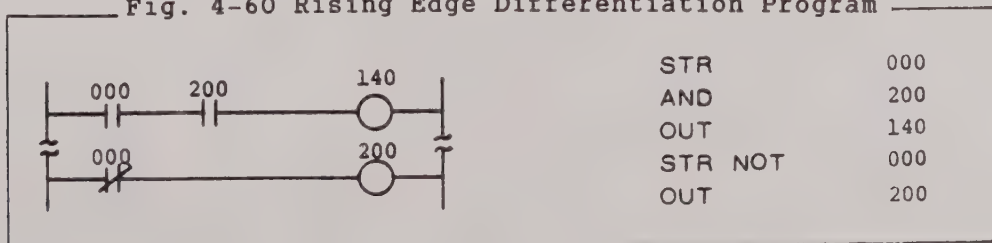


Fig. 4-59 Oscillation Program Example

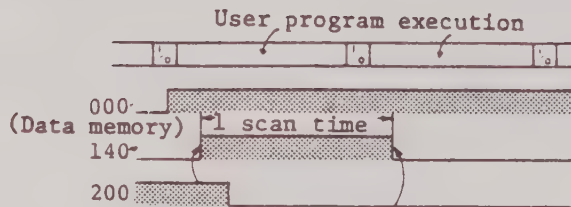
When the operation C is executed in the scan cycle of the user program execution 1, the result of a executed in scan cycle one step before, is used for the operation of C because a was not executed in this scan cycle.

Rising Edge Differentiation:

Fig. 4-60 Rising Edge Differentiation Program



When 000 changes from OFF to ON, 140 goes ON for a period of one scan time.



NOTE-1: Use of F-44 completes the operation by one instruction.

NOTE-2: No pulse is generated when the program sequence is changed.

Falling Edge Differentiation:

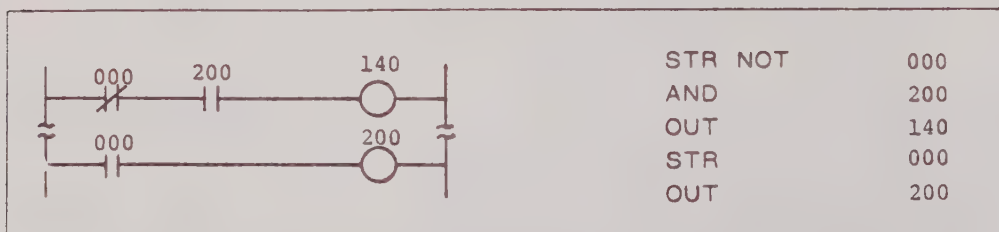
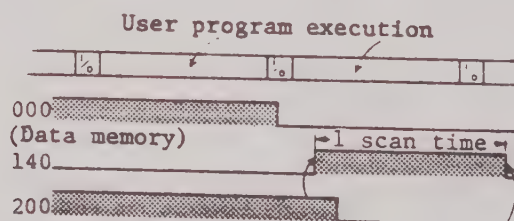


Fig. 4-61 Falling Edge Differentiation Program

When 000 changes from ON to OFF, 140 goes ON for a period of one scan time.

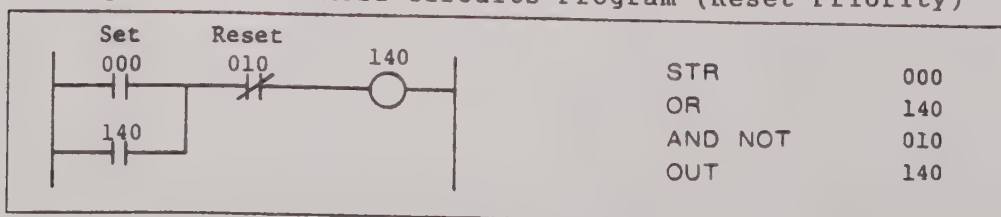


NOTE-1: Use of F-45 completes the operation by one instruction.

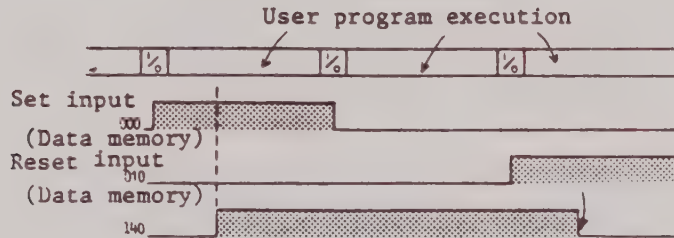
NOTE-2: No pulse is generated when the program sequence is changed.

Self-Hold Circuits (with reset in priority)

Fig. 4-62 Self-hold Circuits Program (Reset Priority)



When the set input is turned ON once with the reset input in ON state (continuing in the ladder chart), the state is retained even after the set input goes OFF until the reset input is turned ON or until power is turned off.



NOTE-1: When the data memory in the retentive function assigned area is used for an output, the state immediately before a power failure can be retained. This is provided that the normally open contact is used for the external contact of the reset input, and AND NOT is programmed. If the normally closed contact is used for the external contact, and AND is used by program, the self-hold will be reset when the source AC power supply is shut off.

Self-Hold Circuit (with set in priority):

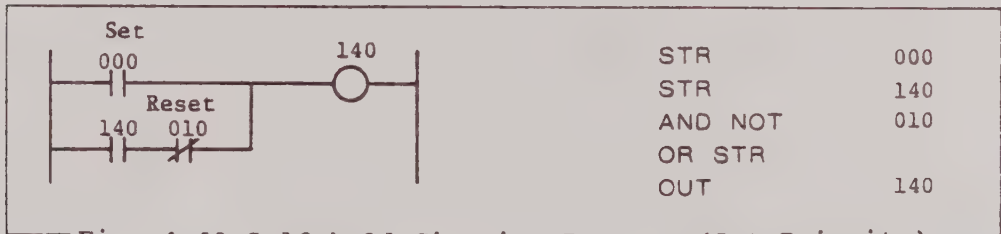


Fig. 4-63 Self-hold Circuits Program (Set Priority)

When the set input is turned ON once regardless of ON and OFF state of the reset input, the output is turned ON and the state is retained even after the set input goes OFF.

Even if the reset input is turned OFF (non-continuing in the ladder chart) with the set input in the ON state, the output retains the ON state with reset being invalid.

Output will be turned OFF when the reset is turned ON or power is turned off with the set input in the OFF state.



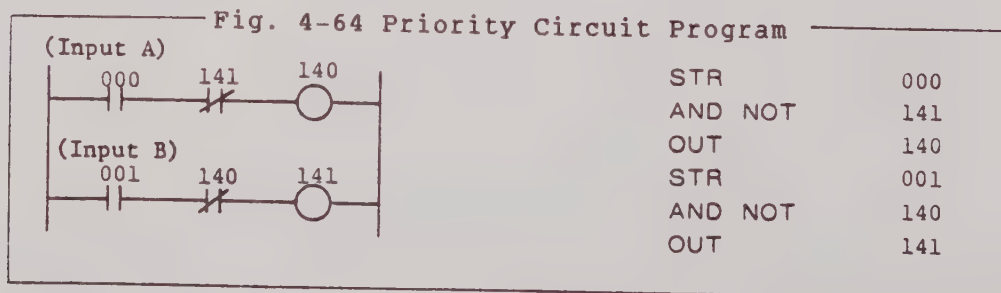
NOTE-1: When the data memory in the retention function assigned area is used for an output, the state immediately before a power failure can be retained. This is provided that the normally open contact is used for the external contact of the reset input and AND NOT is programmed.

If the normally closed contact is used for the external contact and AND is used by program;

1. When a power failure is encountered while the set input is OFF, reset will be carried out even if the reset external contact is closed.
2. When a power failure is restored while the set input is OFF, reset will be carried out even if the reset external contact is closed.

Priority circuit:

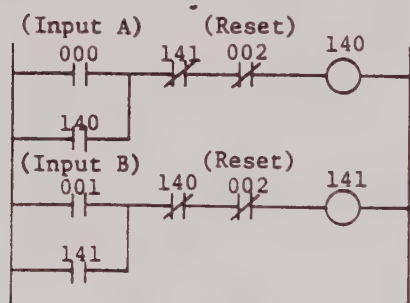
a. Where input is a level signal:



Input A or input B (whichever comes first) takes preference over the other and the input that follows will be treated invalid.

NOTE-1: If the input A and input B went ON in the same scan cycle, the one appearing first in the program takes preference over the others.

b. Where input is a pulse signal



```

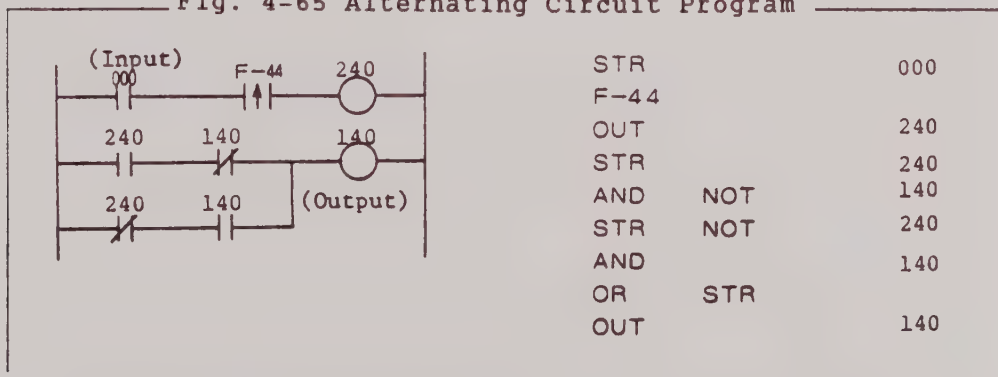
STR      000
OR       140
AND NOT  141
AND NOT  002
OUT      140
STR      001
OR       141
AND NOT  140
AND NOT  002
OUT      141

```

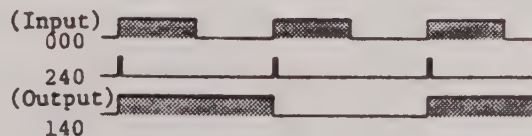
This signal is used for the output that should not turn ON at the same time (such as forward/reverse rotation of the motor).

Alternating Circuit:

Fig. 4-65 Alternating Circuit Program



Each time the input goes ON, the output is inverted. It is possible to produce an alternate output when connected with the contact of the momentary switch.



When this circuit is used repeatedly for n -times, it will constitute the divider circuit of n -stages.

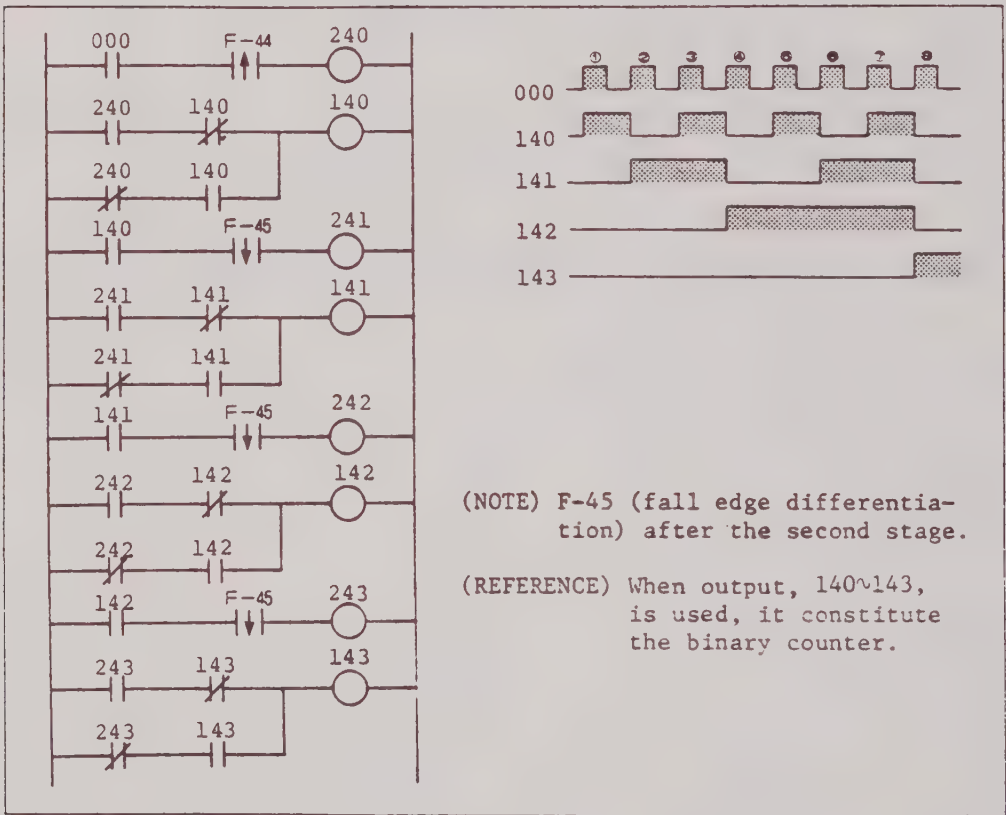
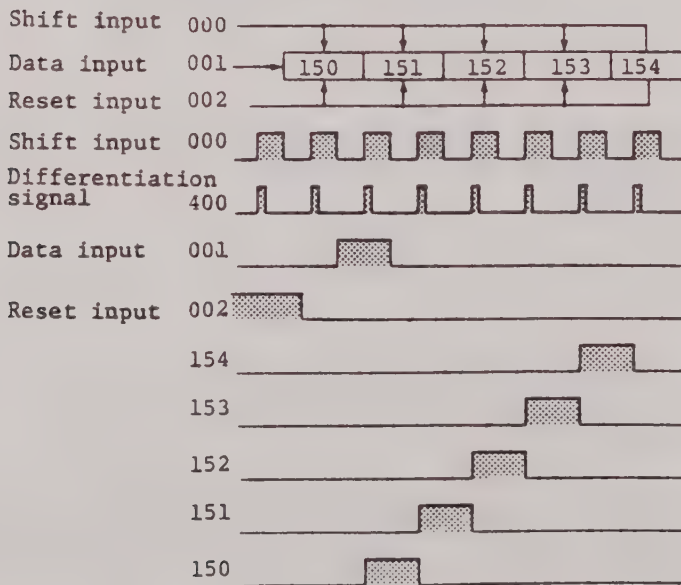
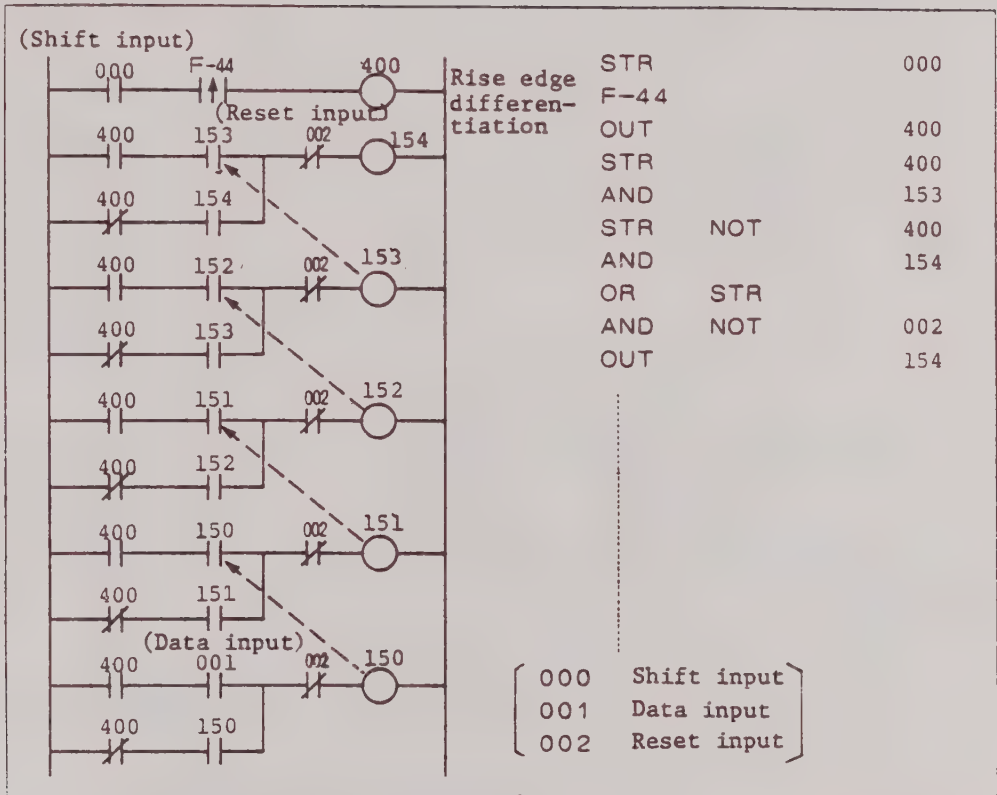


Fig. 4-66 Divider Circuit Example

n-bit Shift Register:

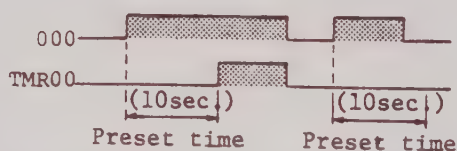
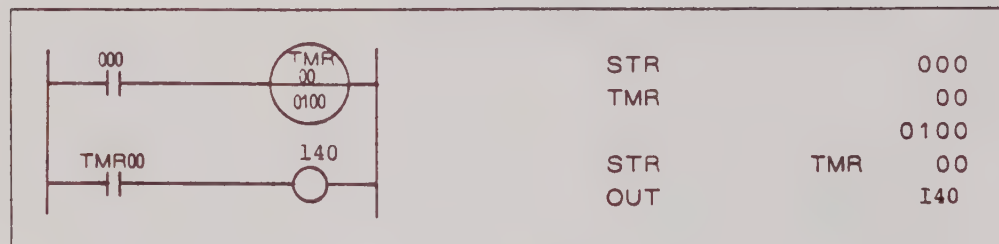


Use of F-60 implements the shift register with one instruction. To retain the shift state at a time of power failure, it becomes necessary to use the retention function assigned data memory are for 150~154.

Fig. 4-67 N-Bit Shift Register

TIMER APPLICATION CIRCUITS

Delay Timer:



Output turns ON delayed by the preset time after the input turns ON. If the input ON time is less than the preset time, the output would not turn ON.

When the input turns OFF, it also turns the output OFF.

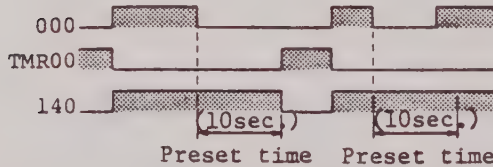
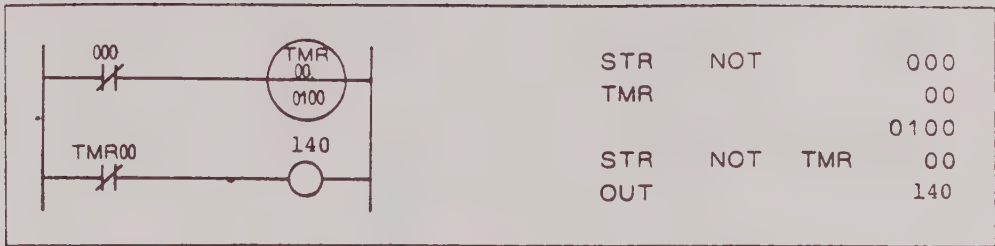
NOTE-1: By means of the system memory #201, it would be possible to choose whether the current value is to be reset or retained at power failure.

000	The current value is reset (the preset value is assumed).
#201 programmed	
001	The current value is retained.

NOTE-2: If a power failure is encountered while the input is ON, the state of the output upon power recovery differs depending on how #201 was programmed.

- (a) #201 is 000 --- Current value is reset
After power recovery, the output turns ON with a delay by the preset time.
- (b) #201 is 001 --- Current value is retained
 - 1. If time expired before the power failure:
After power recovery, the output turns ON in the first scan cycle.
 - 2. If time had not expired before the power failure:
After power recovery, the output turns ON with a delay by the time of (preset value - current value at the time of power failure).

Off Delay Timer:

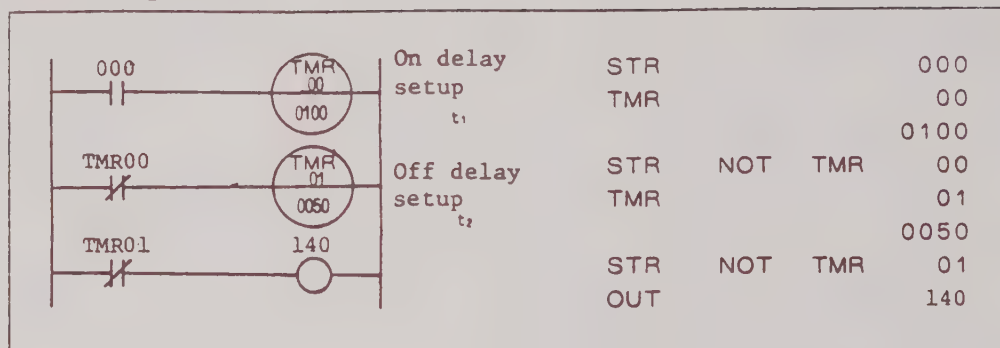


Output turns OFF delayed by the preset time after the input turns OFF. If the input OFF time is less than the preset time, the output would not turn OFF.
When the input turns ON, it also turns the output ON.

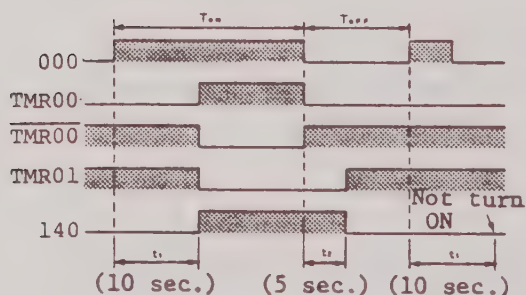
NOTE-1: If a power failure is encountered while the input is OFF with the timer input in the ON state, the state of the output upon power recovery differs depending on how #201 was programmed.

- (a) #201 is 000 --- Current value is reset
After power recovery, the output turns ON with a delay by the preset time.
- (b) #201 is 001 --- Current value is retained
 1. If time expired before the power failure:
The output would not turn ON after power recovery.
 2. If time had not expired before the power failure:
After power recovery, the output turns ON for a period of (preset value - current value at the time of power failure).

On/Off Delay Timer:



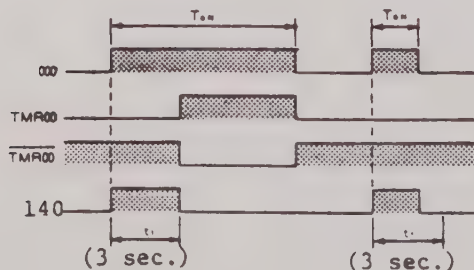
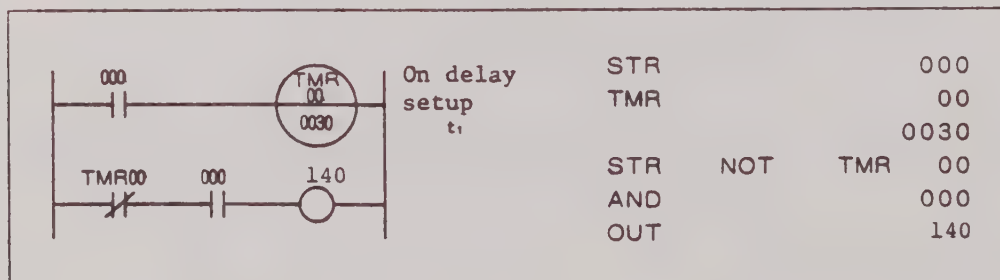
The output turns ON with a delay of t_1 after the input has turned ON, and the output turns OFF with a delay of t_2 after the input has turned OFF.



If the input ON time (T_{on}) is smaller than the ON delay preset time (t_1), the output would not turn ON.

NOTE-1: For state of the output at power failure, refer to "Off Delay Timer NOTE".

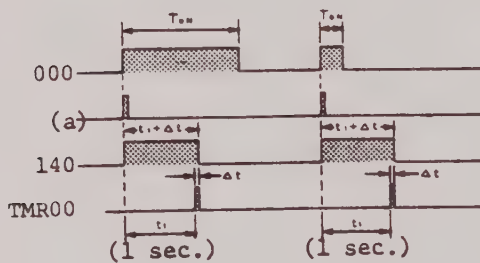
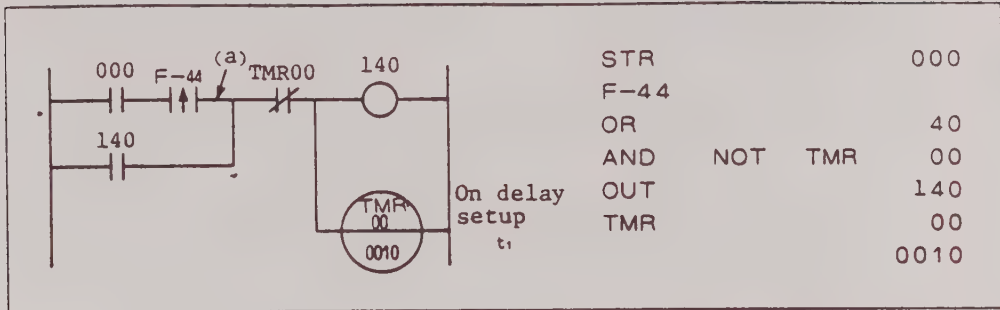
One Shot Timer at the Input Rising Edge (1):



At rising edge of the input signal (OFF to ON), a pulse whose width is the preset time (t_1) is issued.

If the input ON time (T_{on}) is smaller than the preset time (t_1), the width of the output pulse will be T_{on} .

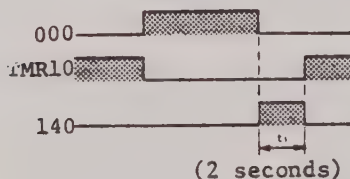
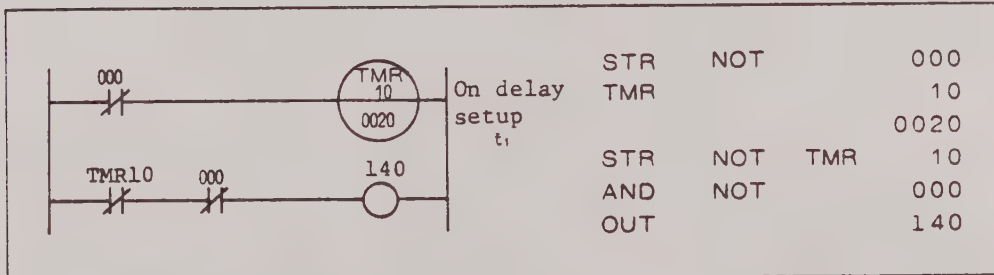
One Shot Timer at the Input Rising Edge (2):



At rising edge of the input signal (OFF to ON), a pulse whose width is the (preset time $t_1 + t$) is issued. Where, t is one scan time.

Irrespective of the input ON time (T_{on}), the output pulse width of the output will be $t_1 + t$.

One Shot Timer at the Input Falling Edge

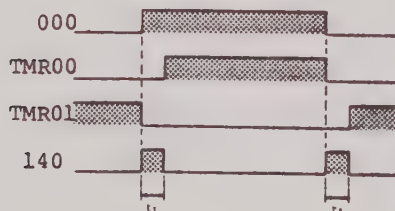
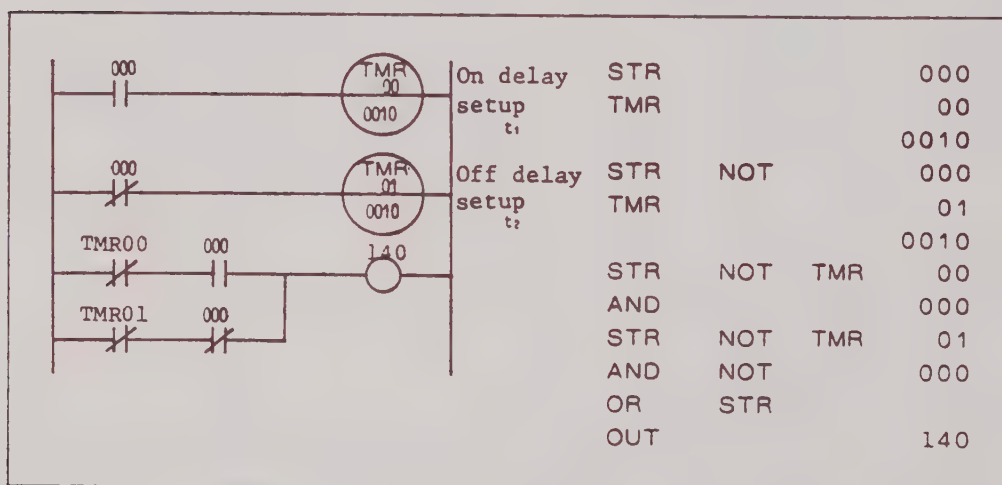


At falling edge of the input signal (ON to OFF), a pulse whose width is the preset time issued.

NOTE-1: When a power failure is encountered while the input is OFF, the output after power recovery may differ depending on how the system memory #201 was programmed.

- (a) #201 IS 000 --- Current value is reset
After power recovery, the output turns ON for a period of the preset time.
- (b) #201 is 001 --- Current value is retained
1. If time expired before the power failure:
The output would not turn ON after power recovery.
 2. If time had not expired before the power failure:
After power recovery, the output turns ON for a period of (preset value - current value at the time of power failure).

One Shot Timer at Rising Edge:

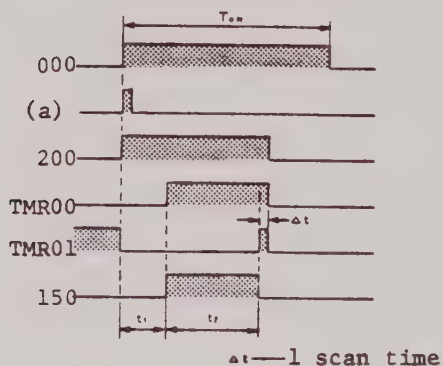
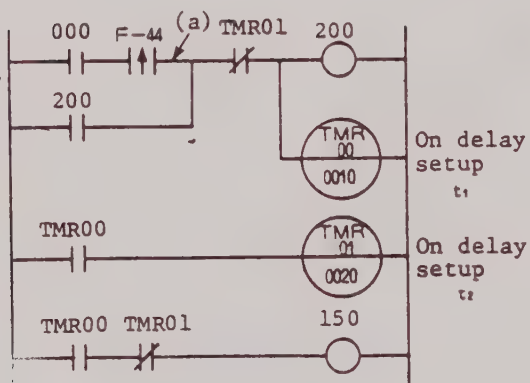


At rising and falling edge of the input, output signals (t_1 and t_2) are turned ON, respectively.

This signal is used to detect a change in the state of the input.

Also used to multiply input pulse frequency.

On Delay One Shot Timer:



```

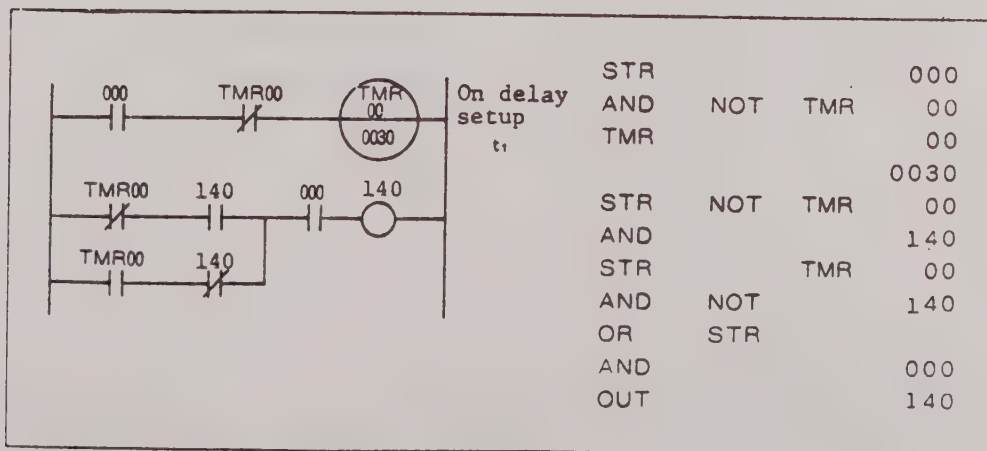
STR                                000
F-44
OR                                200
AND    NOT    TMR    001
OUT                                200
TMR                                00
                                0010
STR                                TMR    00
TMR                                01
                                0020
STR                                TMR    00
AND    NOT    TMR    01
OUT                                150

```

The output having the pulse width of t_2 is issued with a delay of preset value t_1 from the rise edge of the input.

Change of the input during the time ($t_1 + t_2$) is disregarded.

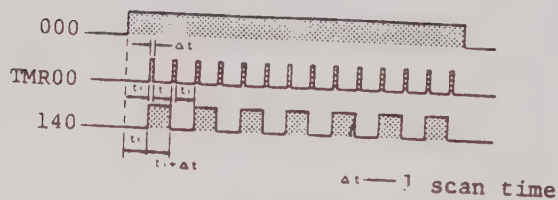
Equispace Pulse Generation Circuit:



```

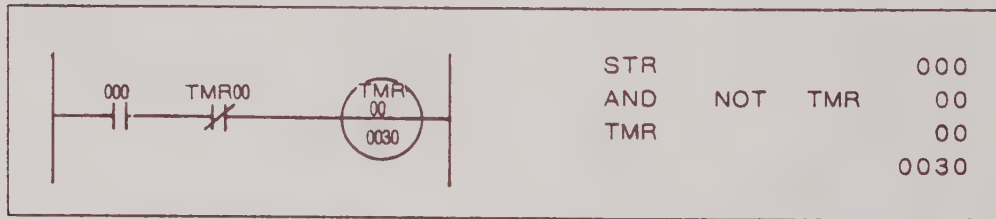
STR                                000
AND    NOT    TMR    00
TMR                                00
                                0030
STR    NOT    TMR    00
AND                                140
STR                                TMR    00
AND    NOT    140
OR    STR
AND                                000
OUT                                140

```

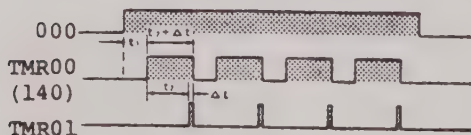
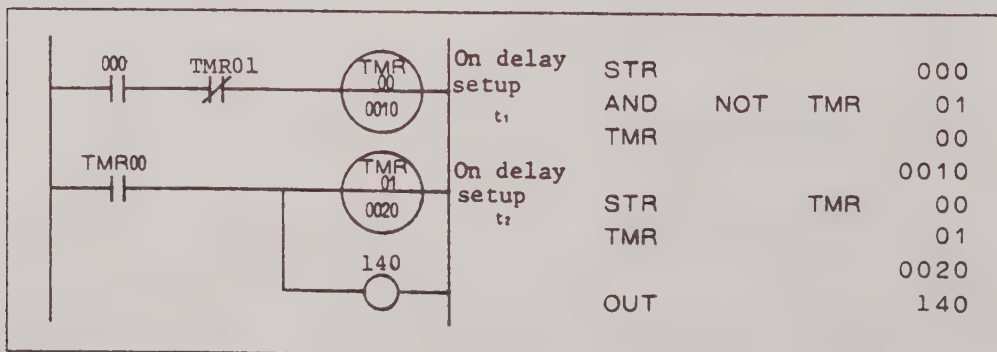


While the input is ON, the pulse whose ON and OFF periods are equal (50% duty cycle) is issued. ON and OFF period may be set as desired using the TMR preset value (t_1). The pulse width shall be $t_1 + t$.

REFERENCE: The pulse have t for the ON period and t_1 for the OFF period can be obtained as illustrated below.



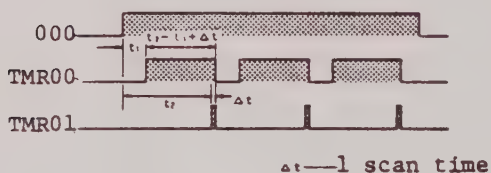
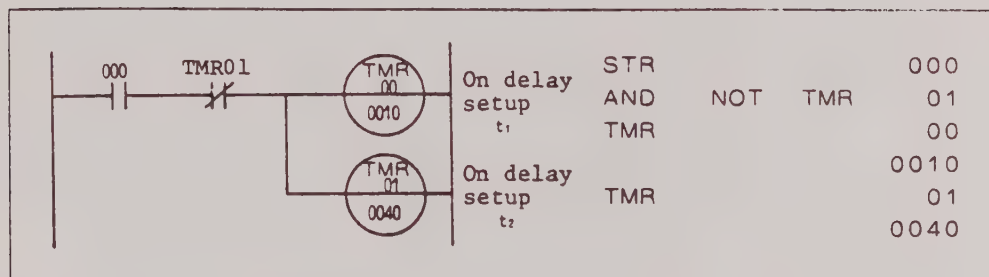
Duty Variable Pulse Generator Circuit (1)



° When the input is ON, the pulse having $t_2 + \Delta t$ for the ON period and t_1 for the OFF period is issued.

Δt — 1 scan time

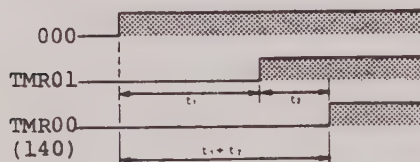
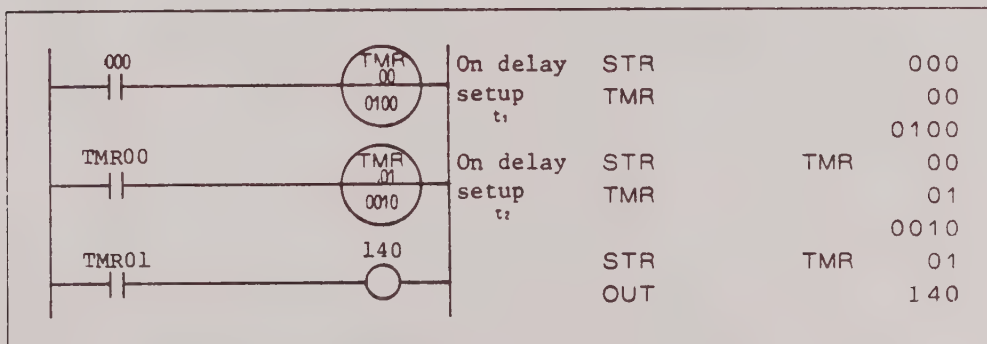
Duty Variable Pulse Generator Circuit (2)



° When the input is ON, the pulse having $t_2 - t_1 + \Delta t$ for the ON period and t_1 for the OFF period is issued.

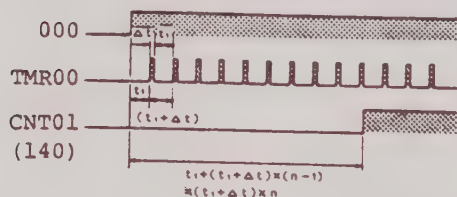
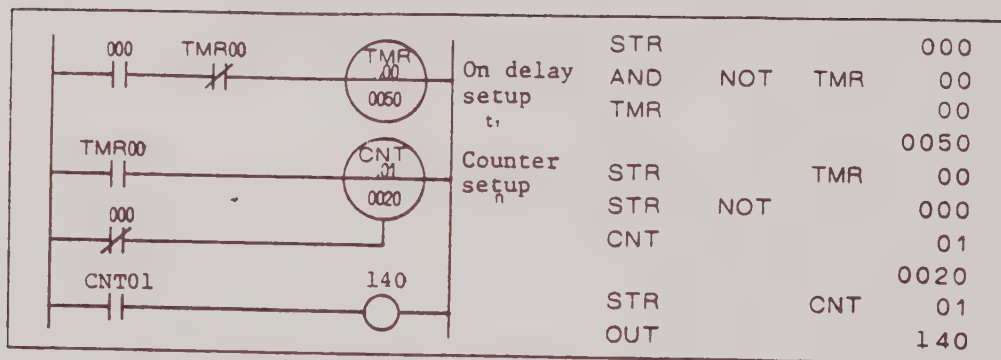
NOTE-1: t_1 must be smaller than t_2 .

Long Time Timer (1):



After the input turned ON, the output becomes ON with a delay of $t_1 + t_2$.

Long Time Timer (2)

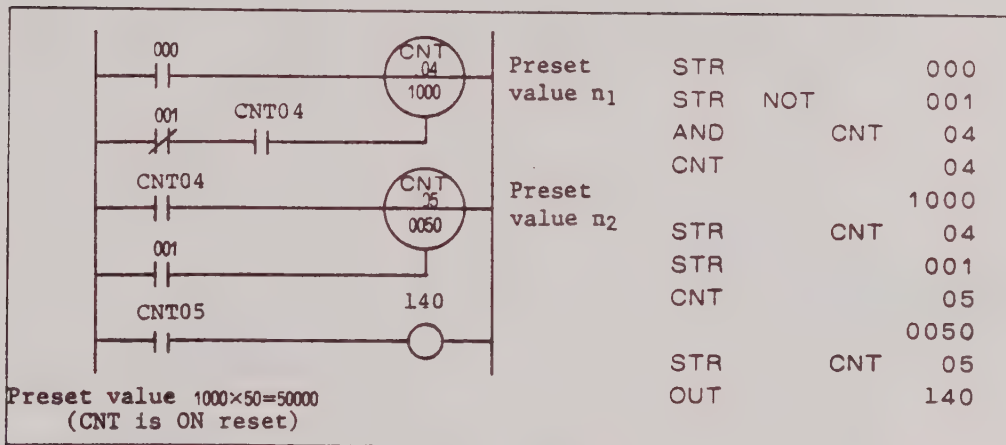


° After the input turned ON, the output becomes ON with a delay of $(t_1 + \Delta t) \times n$.

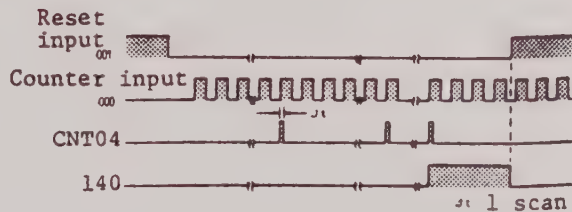
Δt — 1 scan time

COUNTER APPLICATIONS

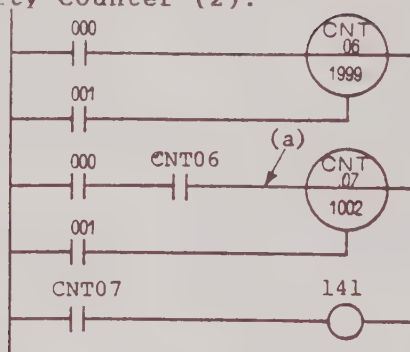
Large Capacity Counter (1):



- ° When the preset value exceeds 1999, programming it in the above manner will realize the counter of the preset value ($n_1 \times n_2$).



Large Capacity Counter (2):

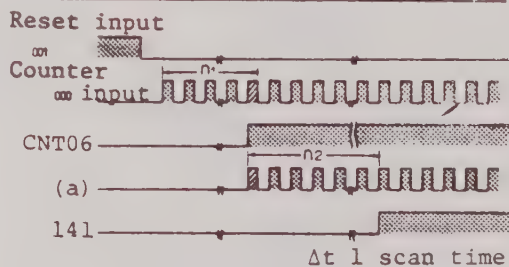


Preset value $1999 + 1002 - 1 = 3000$

(CNT is ON reset)

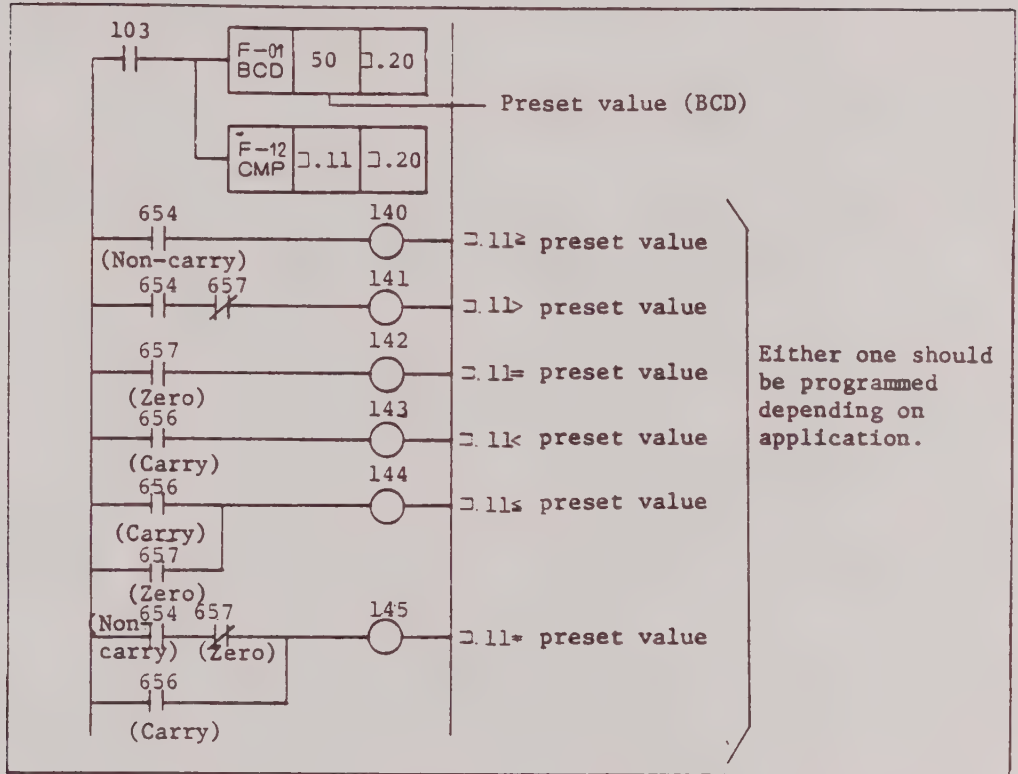
The counter of the preset value is established ($n_1 + n_2 - 1$).

Preset	STR	000
value n_1	STR	001
	CNT	06
		1999
Preset	STR	000
value n_2	AND	CNT 06
	STR	001
	CNT	07
		1002
	STR	CNT 07
	OUT	141

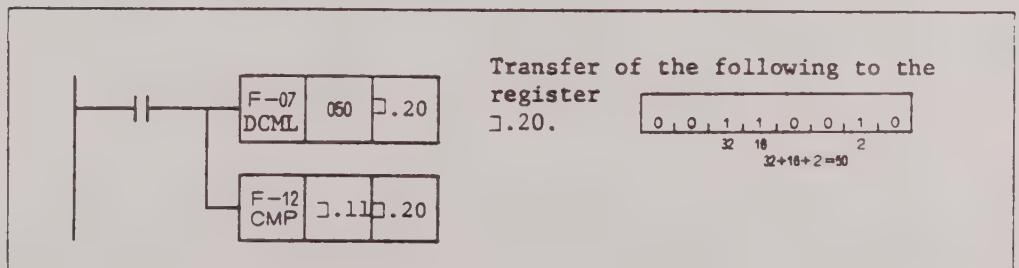


DATA PROCESSING INSTRUCTION APPLICATIONS

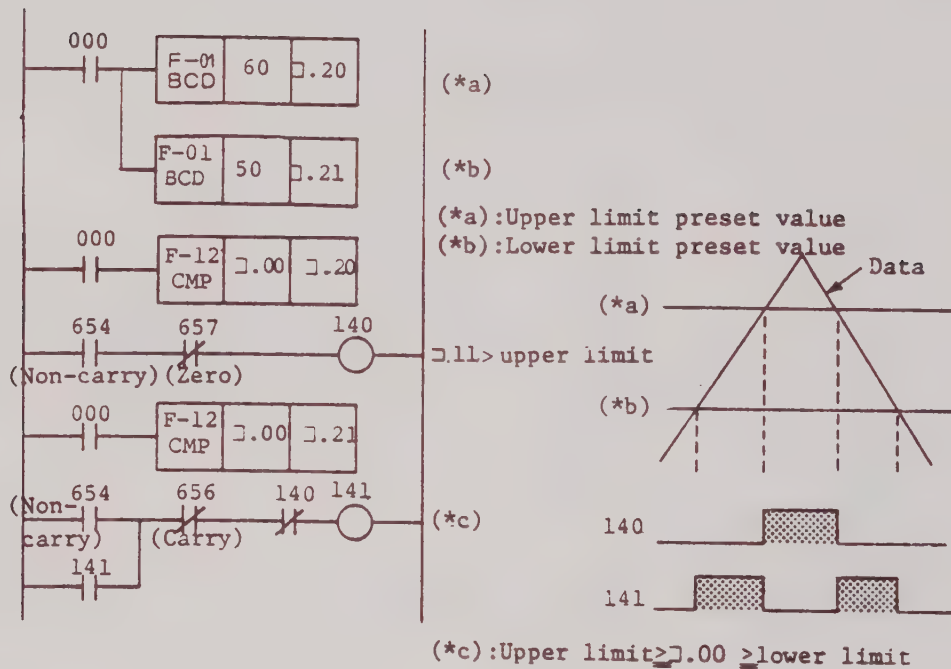
Comparison With Preset Value



REFERENCE: To program the preset value in decimal



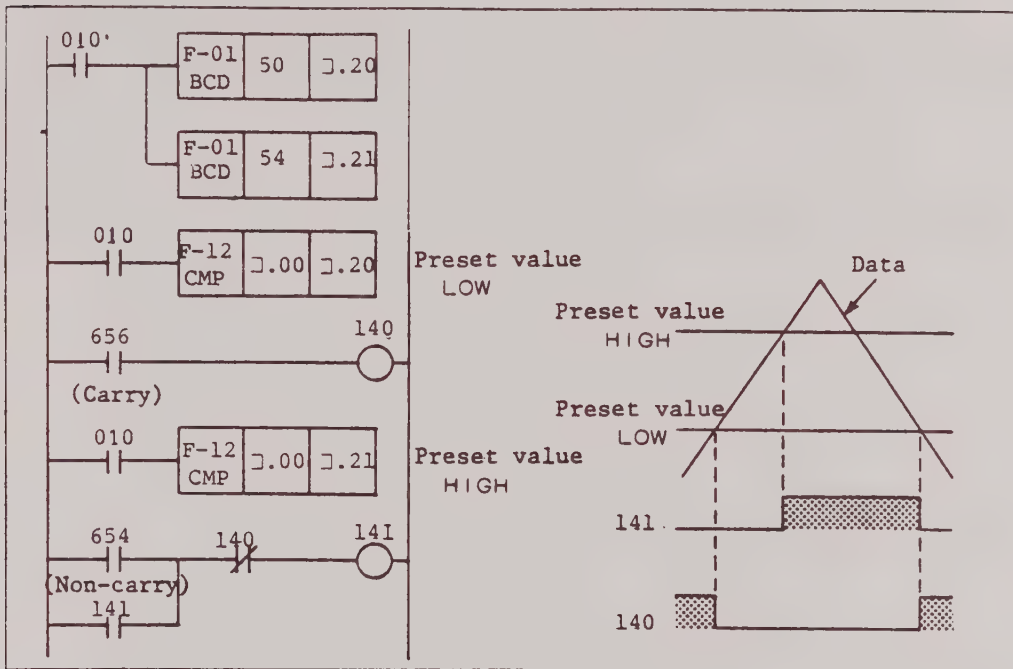
Window Comparator:



When data is within the lower limit preset value and the upper limit preset value, 141 turns ON. This can be used for selecting the acceptable from unacceptable items (GO/NO GO).

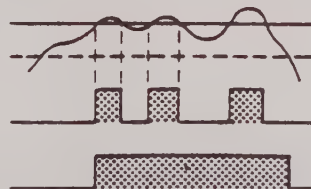
In the above example, the upper limit preset value is set to 60 in BCD, and the lower limit preset value to 50 in BCD. 141 Turns ON when $60 > 0.00 > 50$.

Comparator Circuit Having Undetectable Zone:



When the output from the A/D converter is taken into the input unit, a slight fluctuation in the analog signal may affect the A/D converter output. Use of this program eliminates influence by the fluctuation in the A/D converter low order bits.

Preset value H
 Preset value L
 Comparison without undetectable zone
 Comparison with undetectable zone



In the above example, the high side preset value is set to 54 in BCD and low side preset value to 50 in BCD. 141 turns ON when the contents of J.00 is equal to or larger than 54, but it retains the ON state until the contents of J.00 becomes smaller than 50, after it has turned ON.

Automatic Self-Diagnostics

The PC-0085 Controller ('085A~E) has the following self-diagnostic tests. These tests are performed automatically and do not require the user to enable them.

1. Memory Check - Program memory is checked when executing any instruction. Also, at the start of execution parity of all program memory is checked.
2. Watchdog Timer - The watchdog timer is reset before execution of I/O process. The watchdog timer times up when an error is encountered in the operation cycle.
3. RAM Test - Prior to going into every operational cycle, a read/write test is done to the data memory RAM.
4. I/O Failure - Output data is returned to the CPU through the loopback connector and read to verify that the data was correctly received by the output module.
5. Power Supply - When using the Power Supply module PE-0001, if a power interrupt of less than 10ms is encountered, the machine continues to operate normally. But a power failure longer than 10ms causes the CPU to halt. The operation is resumed automatically as soon as the power interrupt is recovered.

If a gradual supply voltage drop is encountered, the CPU stops when power supply of the control module goes below 90% of the rated voltage. However, the operation is restored automatically when the normal power supply is recovered.

6. Option Module Failure - Existence of any failure is examined by the optional module's firmware.
7. Battery - To determine if battery voltage is within proper level, it is possible to actuate the battery failure indicator or sound buzzer using the special relay 672. Even with a low battery the programmable controller continues operation provided that power is supplied to the programmable controller. But it is advised that the battery be within specifications should a power interrupt occur.

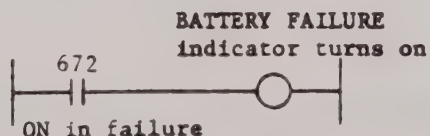


Table 5-1. Self Diagnostic Summary

Item	Contents	PC operating state	Panel indicator			Special relay
			RUN	FAULT	POWER	
Memory failure	Memory check	Stop	Off	On	On	670
CPU failure	Watchdog timer					671
	RAM test (R/W)					
I/O failure	I/O line check			673		
Power supply failure	Power interrupt and supply voltage drop			677		
Option failure	Option module failure	Run	On	Off	On	674
Battery failure	Battery voltage drop					672

Self Diagnostics and Social Relay

The result of self-diagnostics is written in the special relay area of the data memory. When the Programmable Controller stops after detecting an error as a result of self-diagnosis, it is possible to determine the nature of the error by searching the special relay area (670 ~ 677) using the programmer. Because the self-diagnosis runs at every operational cycle, the Programmable Controller will return to normal operation when the error cause is removed. The self-diagnostic special relay is also reset.

IMPORTANT NOTE

ON/OFF state of the output module during error:

Depending on how the system memory (#203) output retention is programmed determines the ON/OFF state of the output modules when the Programmable Controller halts as a result of self-diagnosis.

- #203 = 001 All outputs forced OFF
- #203 = 000 All outputs retains the ON/OFF state before the stop.

Depending on the nature of the error all outputs may not turn off. But in the case of an I/O failure, all outputs will turn OFF even if #203 is set to 000.

Hardware Diagnostic

In addition to the automatic self tests, the following items can be checked manually:

1. System ROM CRC check
2. Display LED on/off check
3. Each key of the Programmer
4. Buzzer function

1. Checking The System ROM CRC. With the PP-0105 Programmer connected to the Controller, remove power and wait 10 seconds. While pressing 0 and CLEAR keys, power up the system. The current version number of the ROM CRC code will be displayed.

2. Checking the Display LED's. Following the ROM CRC check you can check the display LED's by pressing NEXT ADRS and cycling through four LED test patterns by pressing the NEXT ADRS key again.

At the start of the first pattern all LED's including the four 7-segment displays will light. After pressing NEXT ADRS for the second time, one of the 8 LED's on either side of the four 7-segment displays (digit display) and a segment of each digit display itself will go off, followed by another, and another, until all are off. Then the cycle will reverse itself lighting an LED and a segment of each digit display (in reverse order), until all are on again thus completing the second pattern.

A third test pattern will then begin where all LED's and segments except the first one (right) will go off. The first segment display will indicate the number "8", the second, third, and fourth following successively. The group of eight LED's to the left of the segment display will light followed by the group to the right. The fourth test pattern begins with the first segment display to go off followed by the next etc. in the same order that they were lit in the third test pattern. The first test pattern will then resume and cycle through until the NEXT ADRS is pressed again to begin the keys and buzzer test.

Preventive Maintenance

The following items should be checked daily for proper operation.

General Site Conditions

Item	Verify	Standards
Ambient temp.	Check if area is within the range of the specifications, Cabinet temp. will be the ambient temp. when installed inside cabinet.	0 to 60° C
Ambient humidity		35 to 90%RH
Ambient air		Free of corrosive gas
Vibration		None
Shock		None

P.C. Check

Item	Verify	Standards
Control unit ERROR lamp	Visually check the FAULT lamp.	Must be OFF
Battery	Check that battery life has not expired.	Must be within the expiration date as indicated on label.
After Installation	Check that the unit is firmly secured.	Must be firmly fastened.
	Check that the ter- minal board screws are tight.	Must be firmly fastened.
	Check that the I/O cable chain is connected and the last I/O connector is terminated.	Must be firmly connected.

I/O Unit Check

Item	Verify	Standards	Model
Input power supply or output power supply	Check that the supply voltage to I/O units is within the given rating.	• 110/120 VAC input 85-132 VAC	DI-1131
		• 12/24 DC input 10-28 VDC	DI-1133
		• 220/240 VAC input 170-250 VAC	DI-1135
		• 110/120/220/240 VAC output 15-250 VAC	DO-1130
		• 12/24 VDC output 10-28 VDC	DO-1132
		• Relay output AC: 5-250 V DC: 5-60 V	DO-1136
Installed I/O	Check that every unit is secured firmly.	Must be firmly fastened.	
	Check that the terminal board screws are firmly fastened.	Must be firmly fastened.	

Power Supply Unit Check

Item	Verify	Standards
After Installation	Check that the expansion power supply unit is secured firmly.	Must be firmly secured.
	Check that ter- minal board screws are firmly fastened.	Must be firmly fastened.

Other Checks

Verify the program on the cassette tape to be sure it does not differ from the program in operation.

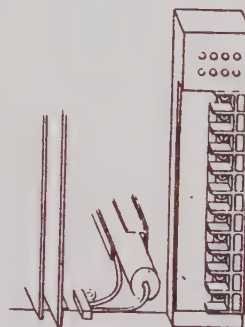
Battery Replacement

The battery will retain the contents of the program and data memory should a power failure occur. To ensure that this backup capability is retained, the memory backup battery cell used for this unit must be replaced with a new one before the expiration date. See the label posted on the control unit. It is possible to replace the battery without removing power to the control unit.

A) Battery Identification Number: DUNT-5211NCNG

Replace the battery as follows:

1. Remove the cover of the Controller module by pressing the mounting tabs on upper and lower corners of the controller until they release from slot.
2. Remove the battery to be replaced by disconnecting the 4 pin connector. Slide battery out.
3. To install a new battery, reverse the procedure. The connector is keyed to prevent a mis-connection.
4. Post new battery expiration label.



System Troubleshooting

Follow this procedure to track the cause of a failure.

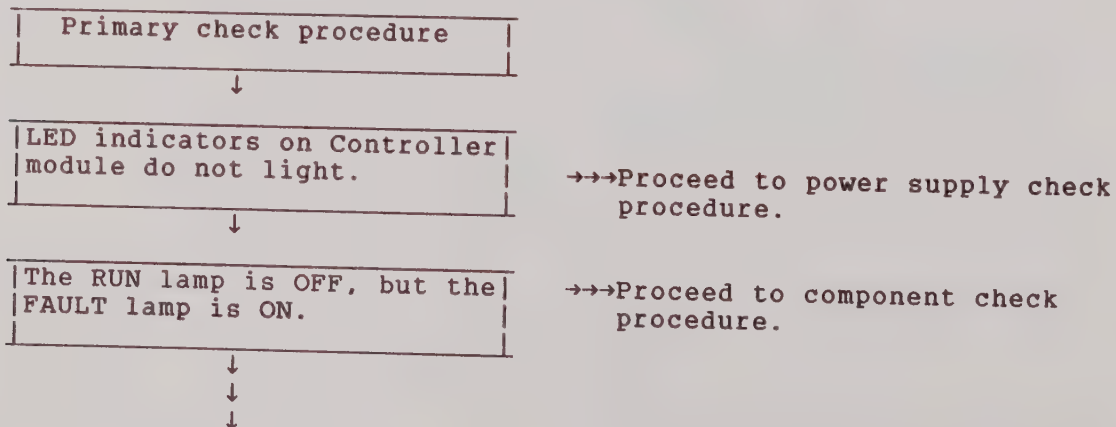
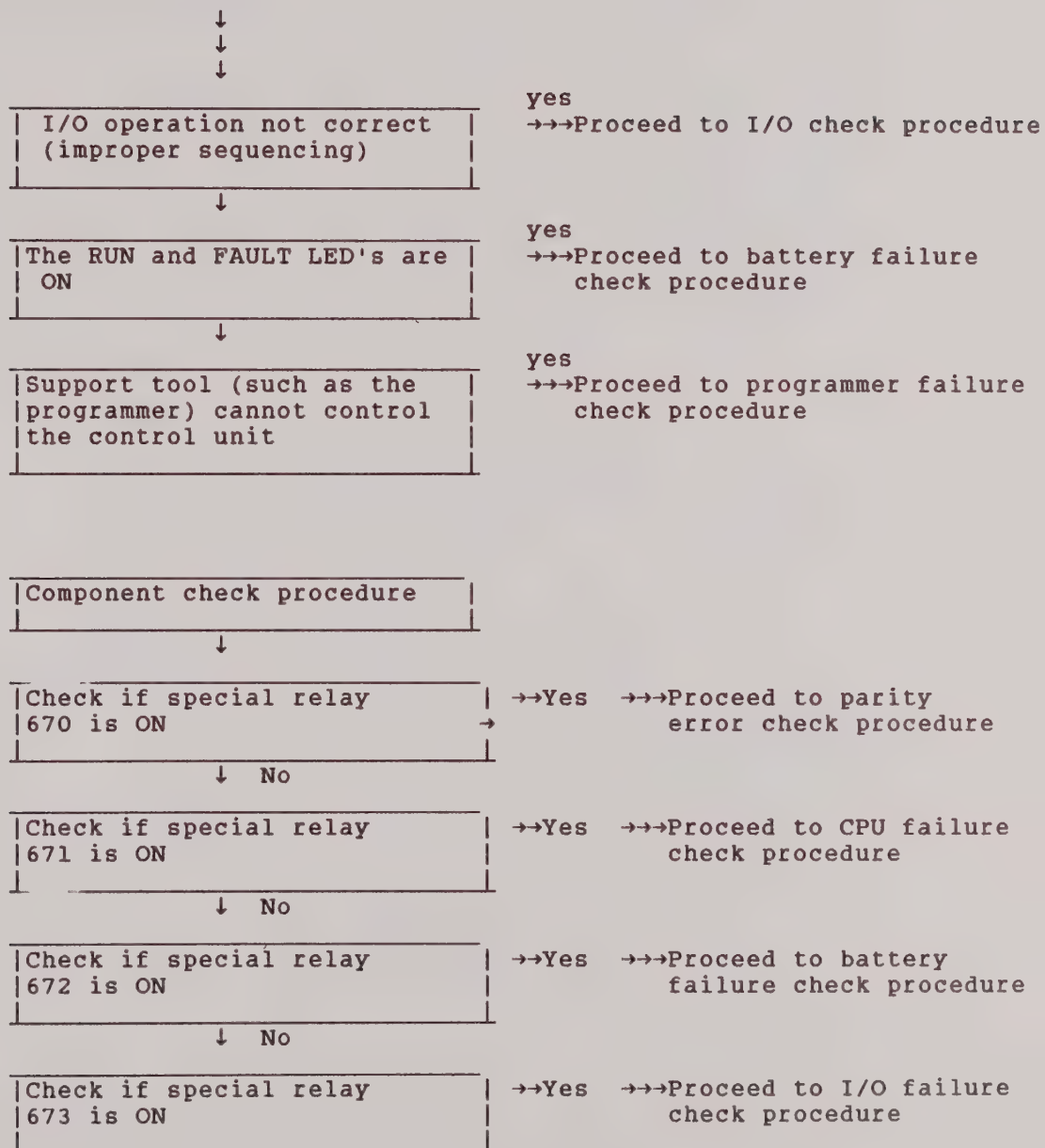


Fig. 5-1 System Troubleshooting Procedure

Primary Check Procedure (cont.)



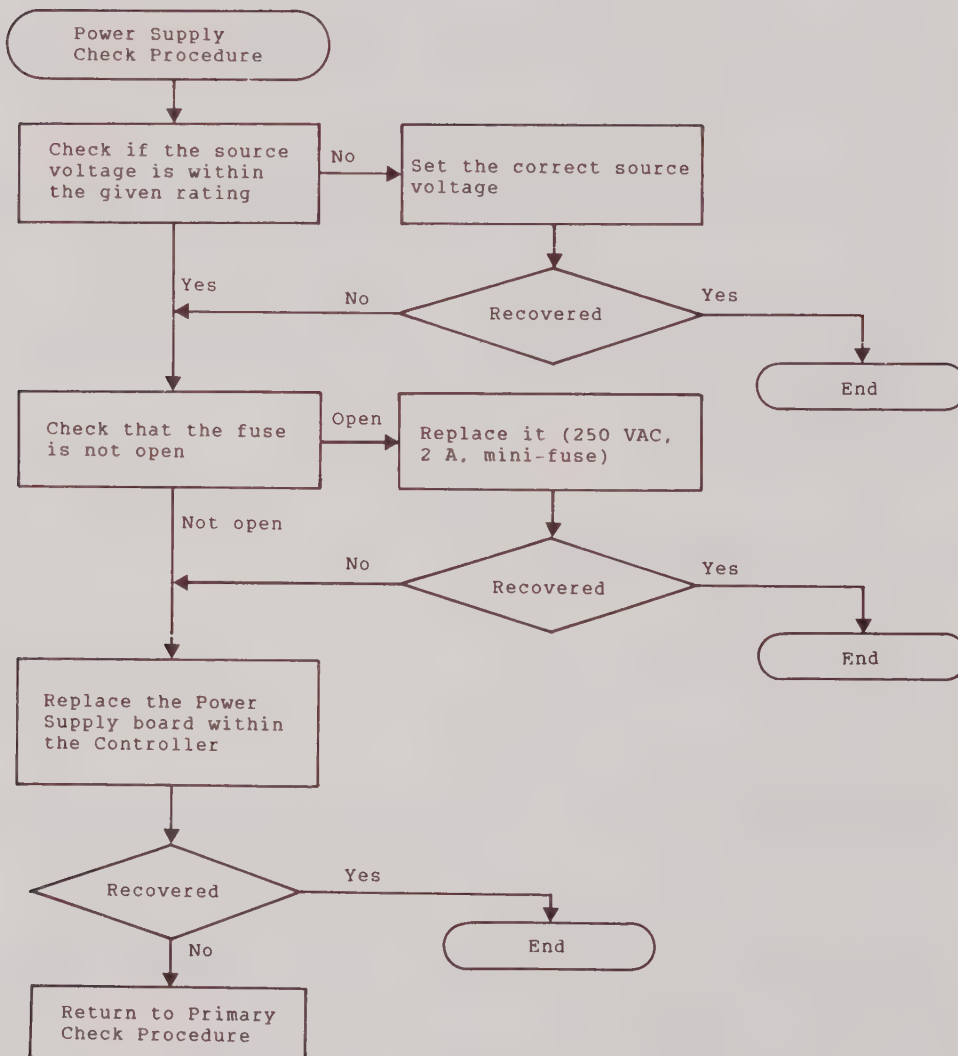


Fig. 5-2 Power Supply Check Procedure

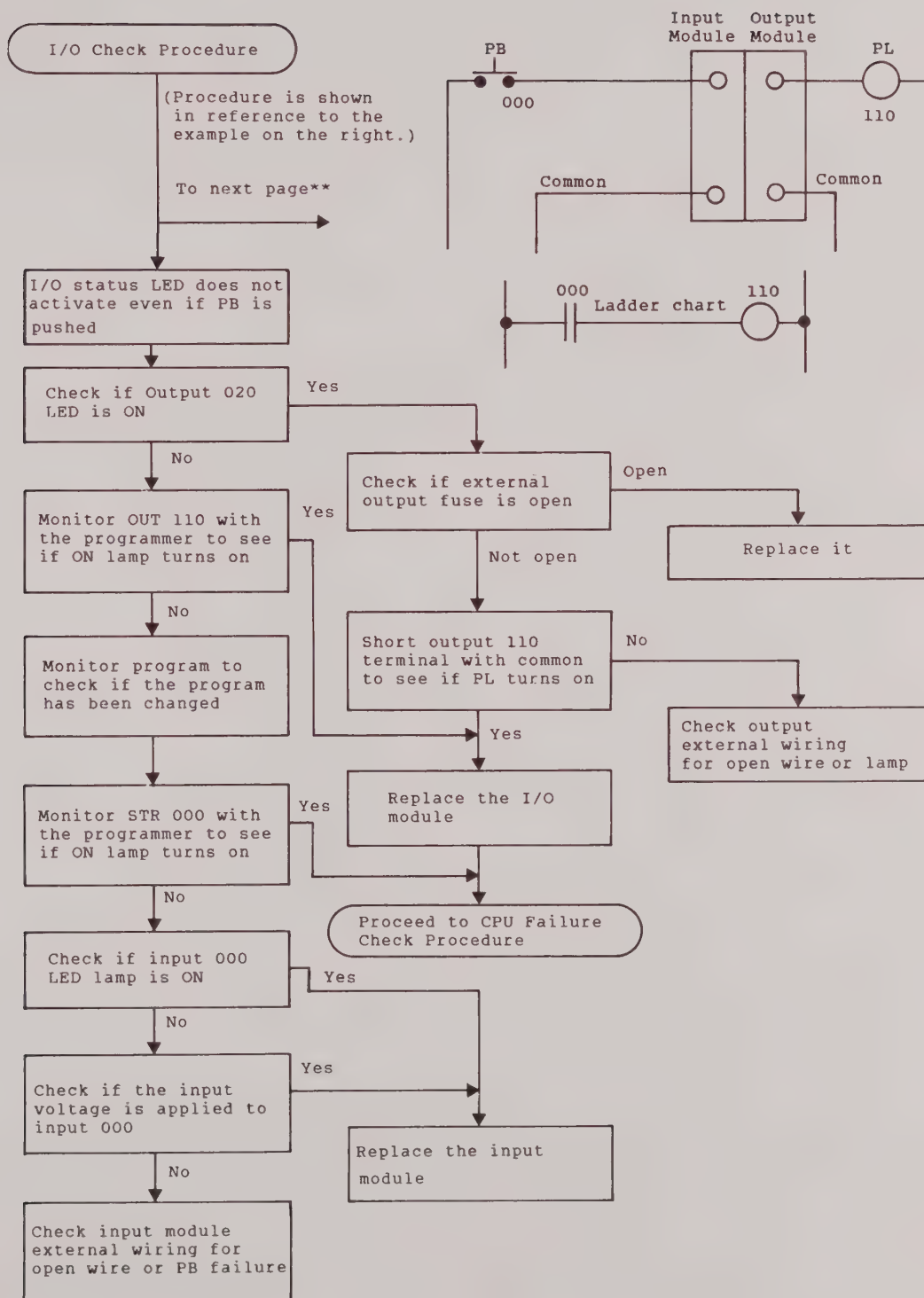


Fig. 5-3 I/O Check Procedure

I/O Check (con't)

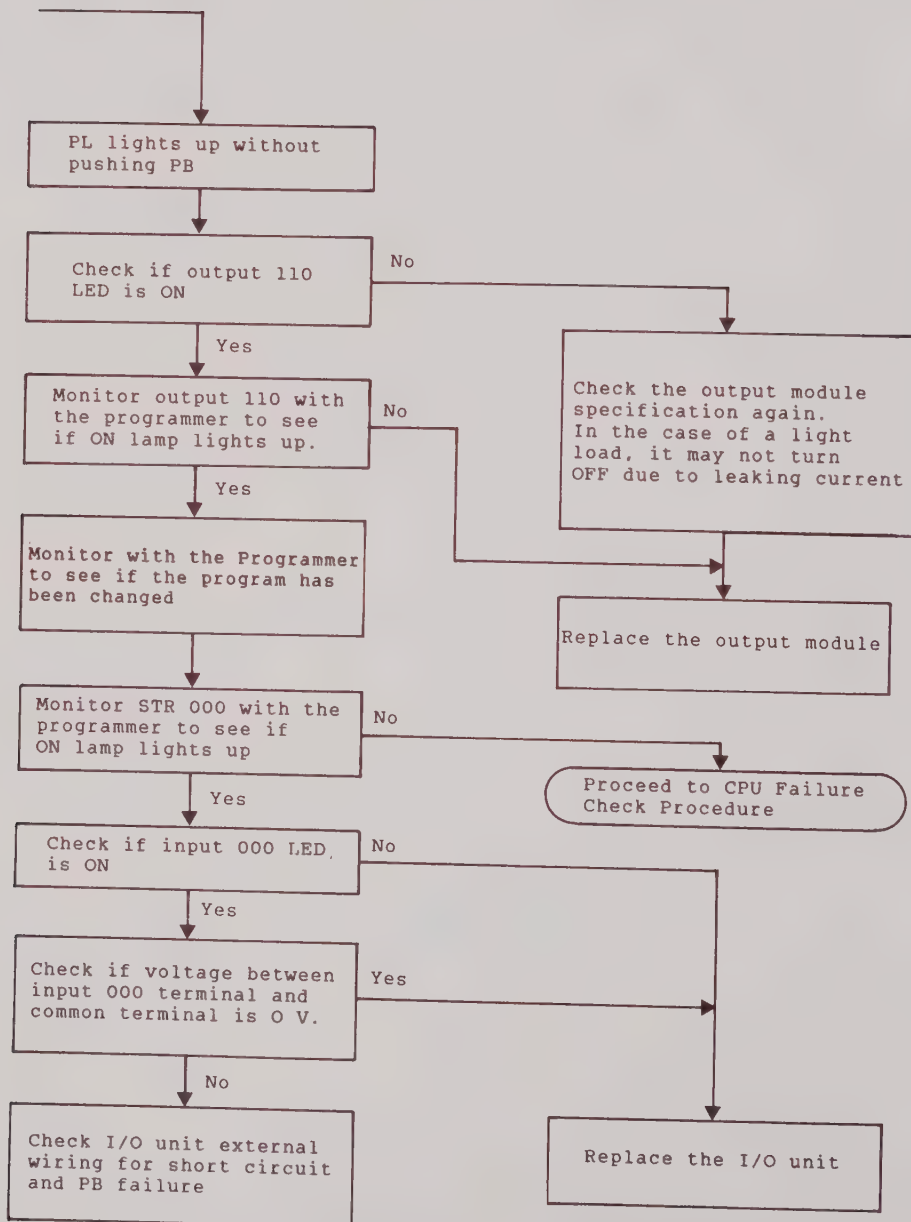


Fig. 5-3 I/O Check Procedure (cont.)

Fig. 5-4 Battery Failure Check Procedure

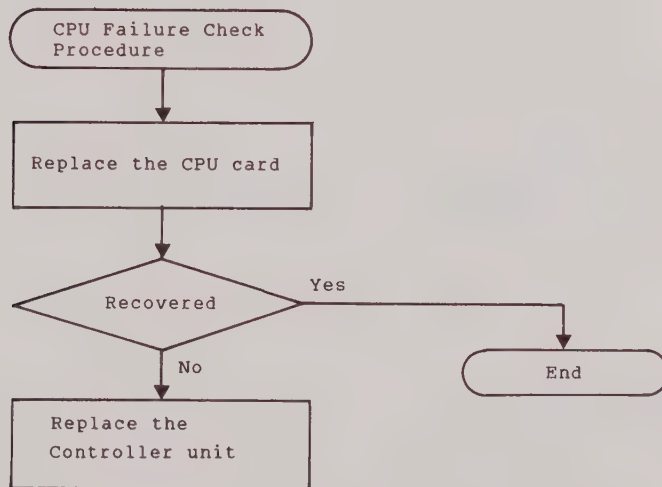
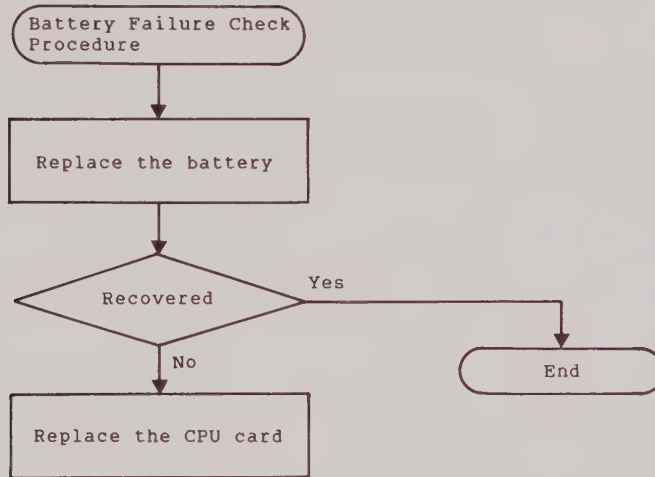


Fig. 5-5 CPU Failure Check Procedure

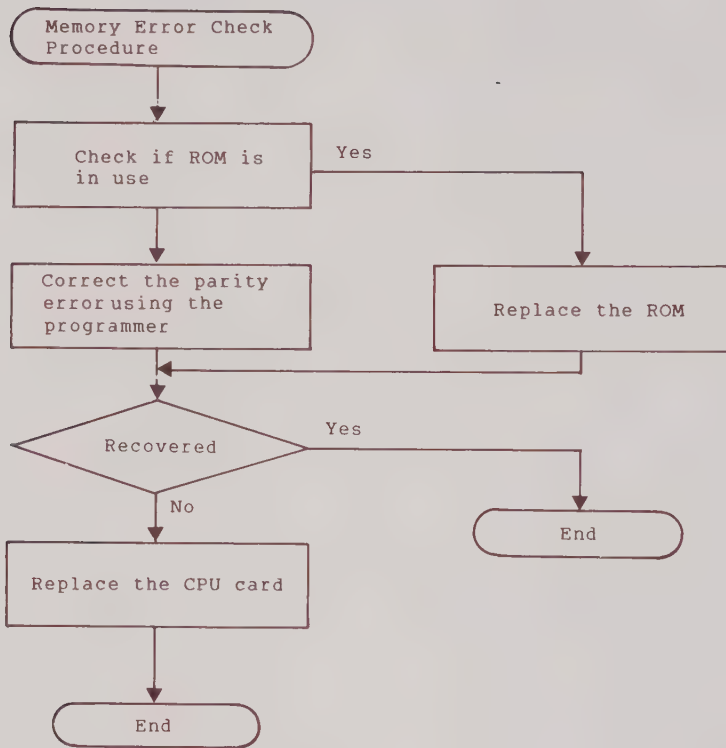


Fig. 5-6 Memory Error Check Procedure

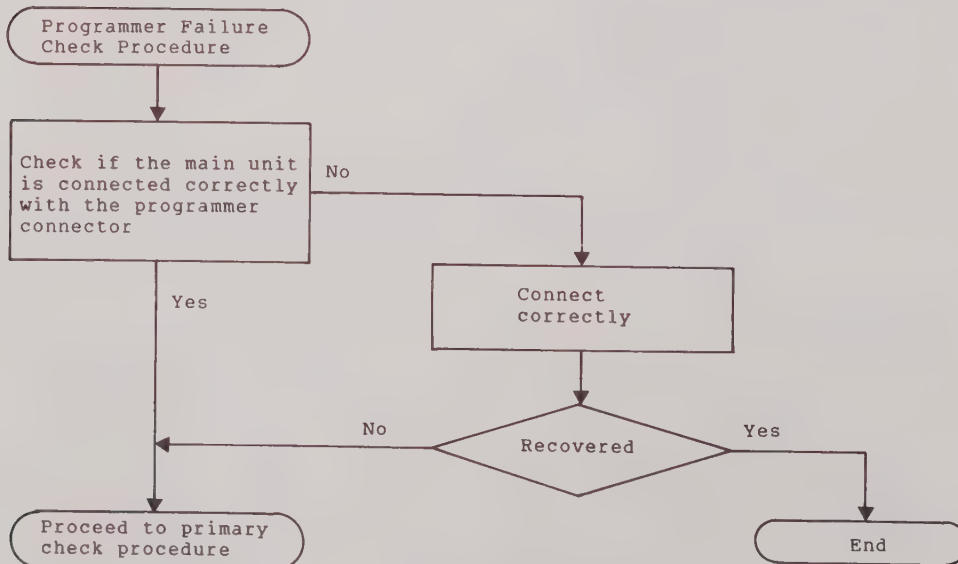


Fig. 5-7 Programmer Failure Check Procedure

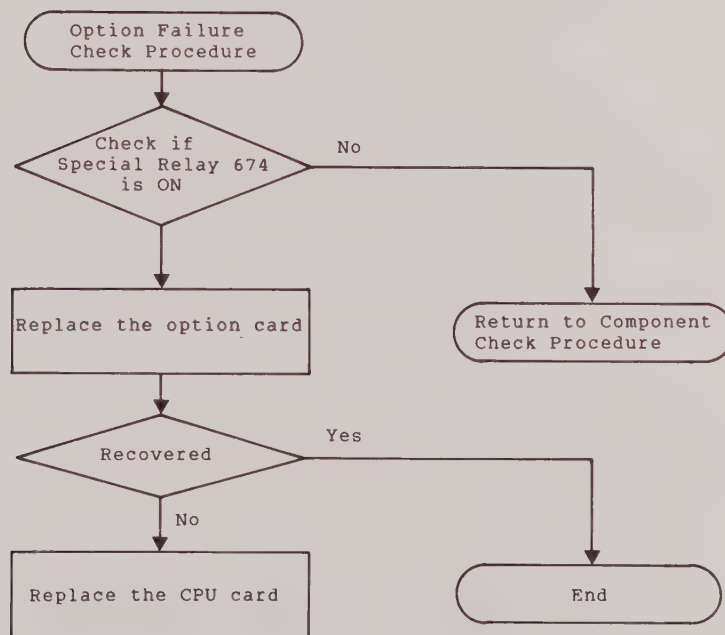
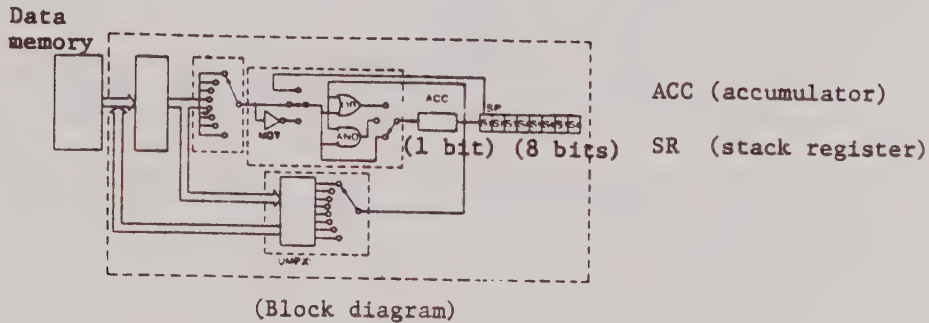


Fig. 5-8 Option Failure Check Procedure

APPENDIX A

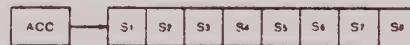
BIT PROCESSING

Bit processing is the logical operation of the contact signal. The following figure shows the block diagram of the PC's CPU.



ACC (accumulator): A single bit register in which a result is stored.

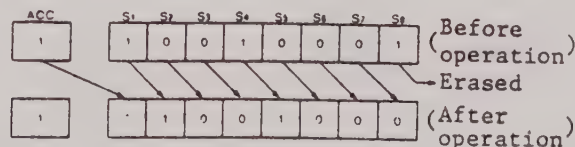
SR (stack register): An 8-bit register in which the intermediate result is stored during processing of a serial/parallel circuit or an application instruction that has a multiple of input conditions.



Shift register action during execution of the STR or STR NOT instructions is as follows:

With the STR and STR NOT instructions, the ON/OFF state of the bit read from the data memory is stored in the accumulator. With the STR NOT instruction, the bit is inverted before being stored in the accumulator.

The ON/OFF information previously stored in the accumulator shifts to S₁, the information in S₁ to S₂, S₂ to S₃...S₇ to S₈. The information in S₈ is then "erased".

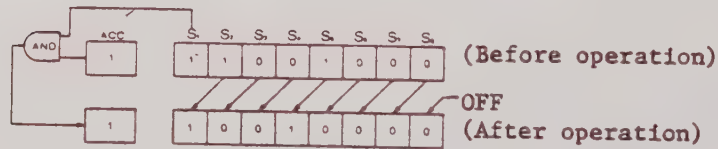


Bit Processing (cont.)

Shift register action during execution of AND STR or OR STR instructions:

With the AND STR and OR STR instructions, the ON/OFF information in S_1 is ANDed or ORed with the accumulator contents and the result is stored in the accumulator.

The ON/OFF information of S_1 becomes irrelevant after the operation is "erased". The information in S_2 shifts to S_1 , S_3 to S_2 , S_4 to S_3 ... S_8 to S_7 . S_8 is then set OFF.



The diagram illustrates the power supply and monitoring system for the TMS320C49 DSP. A 24VDC 2A power supply feeds a POWER FAIL DETECTOR, which provides 5VDC and 24VDC to the system. The CPU (*a) is connected to a Programmer via a high-speed counter input and a high-speed counter signal. The CPU is also connected to an I/O interface, which provides 24VDC to the CPU. The CPU is connected to ROM, USER ROM, and RAM (*b). The CPU is connected to a WATCHDOG TIMER and a BATTERY VOLTAGE DETECTOR, which is connected to a Lithium Battery. The CPU is connected to a POWER FAIL DETECTOR, which provides 5VDC and 24VDC to the system. The CPU is connected to a WATCHDOG TIMER and a BATTERY VOLTAGE DETECTOR, which is connected to a Lithium Battery. The CPU is connected to a POWER FAIL DETECTOR, which provides 5VDC and 24VDC to the system.

*b Program memory, system memory, data memory, and differential memory.

